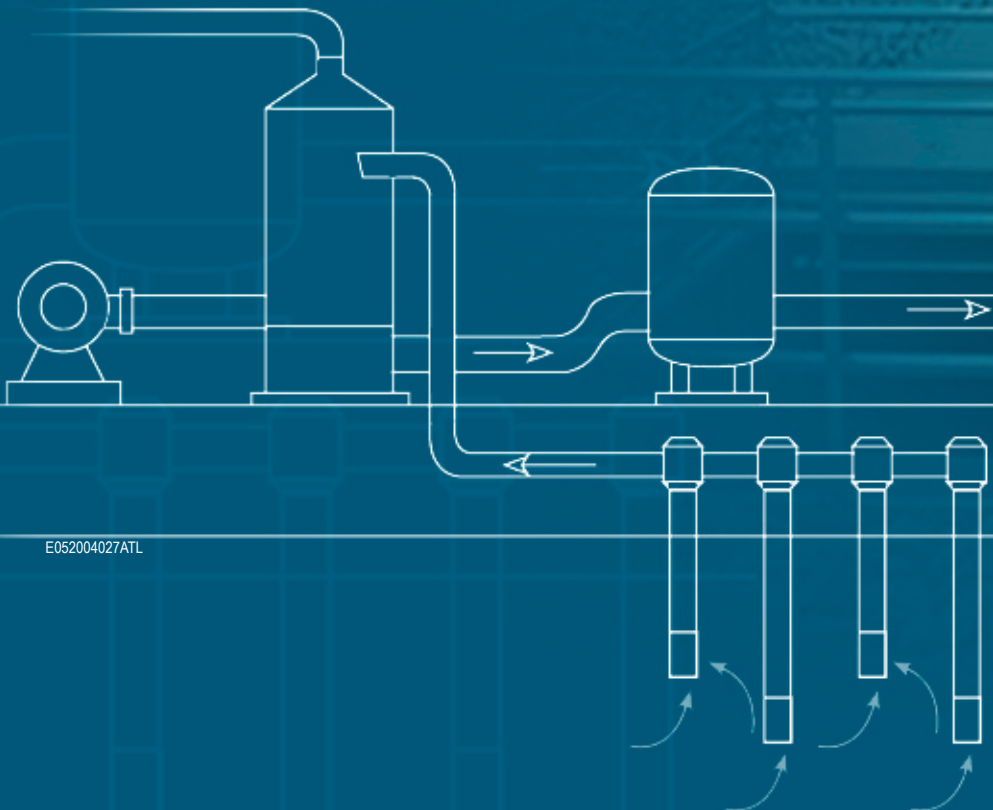


# **CONSTRUCTION OF SWMU 74 GROUNDWATER EXTRACTION AND CONVEYANCE SYSTEM ARNOLD AIR FORCE BASE, TENNESSEE**

PREPARED FOR:  
DEPARTMENT OF THE AIR FORCE  
ARNOLD AIR FORCE BASE, TENNESSEE



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AUGUST 2004

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# **Finding of No Significant Impact:**

## **Arnold Air Force Base**

### **Construction of SWMU 74 Groundwater Containment System**

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Arnold Air Force Base (Arnold AFB) has prepared an Environmental Assessment (EA) that evaluates the potential environmental impacts associated with the construction and operation of a new groundwater extraction and conveyance system.

### **Description of the Proposed Action**

The Proposed Action is designed to lower the concentration of trichloroethene (TCE) and other chlorinated solvents in the northwest groundwater plume extending beyond the Base boundary. The area encompassing this plume has been designated Solid Waste Management Unit 74 (SWMU 74).

The Proposed Action would lower the TCE concentration through implementation of the SWMU 74 groundwater extraction and conveyance system which would discharge through the existing J4 Test Cell Groundwater Treatment Unit (GWTU). Intermediate and deep groundwater monitoring wells (22 total) would be installed along the groundwater plume. The major elements include:

- Groundwater extraction system consisting of five wells along Air Field Road approximately 3,700 feet (0.7 mile) from the air field. Four new extraction wells and existing extraction well 705 would be used.
- Transfer lift station and high-density polyethylene (HDPE) transmission water line to convey contaminated groundwater to the existing J4 Test Cell GWTU.
- Modifications to the existing J4 Test Cell dewatering system to provide a steady-state flow to the existing J4 GWTU.
- Installation of a groundwater monitoring system, including 12 wells (4 intermediate wells and 4 nested pairs of intermediate and deep wells) and 10 piezometers (5 pairs of intermediate and deep piezometers).
- Construction of new gravel roads to three monitoring well/piezometer locations to allow installation and monitoring of the wells.
- Discharge through the J4 Test Cell GWTU, which is permitted by the Tennessee Department of Environment and Conservation (TDEC) under the National Pollutant Discharge Elimination System (NPDES) Permit No. TN0003751.

The J4 Test Cell GWTU consists of two low-profile air strippers, a carbon adsorption tank, a pH adjustment tank, and a discharge to the Retention Reservoir. The J4 Test Cell GWTU would have sufficient capacity to treat the existing J4 Test Cell dewatering flows plus the additional 100-gallon-per-minute (gpm) flow that would be supplied by the MW-450 area groundwater extraction system after the proposed modifications are made. The carbon adsorption tank would be maintained in standby. The volatile organic compound (VOC) removal efficiencies (99%) are very high even without the carbon step.

The configuration changes to the J4 Test Cell dewatering system include the following:

- Three new pumps of approximately 150-gpm capacity, with piping modifications to the lift station
- Electrical/control modification for pumps and control features at the J4 Test Cell GWTU.

- Valving/controls on the two 2,500-gpm pumps to redirect flow into the J4 Test Cell.

Effluent from the J4 Test Cell GWTU would continue to discharge into the Retention Reservoir after the modifications.

## **No-Action Alternative**

The No-Action Alternative would be to not extract groundwater from the MW-450 area extraction wells in order to lower the TCE concentration. The groundwater would continue to pass beyond the Base boundary with elevated levels of TCE. As a result, the No-Action Alternative does not meet the stated objective.

## **Environmental Consequences**

No significant negative environmental or socioeconomic consequences were identified in the EA for the proposed project. Potential minor impacts to hydrology could result from groundwater pumping, but the low pump rate (100 gpm) would minimize such impacts. Minor ground disturbance would also occur during installation of monitoring wells and access roads. It was determined that the proposed project would benefit the environmental mission at Arnold AFB and improve water quality by reducing the concentration of TCE in groundwater outside of the Base boundary.

## **Restrictions**

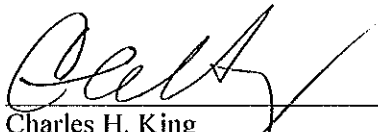
No restrictions are necessary for the Proposed Action.

## **Conclusion**

The attached EA was prepared pursuant to Air Force Instruction (AFI) 32-7061, 32 Code of Federal Regulations (CFR) 989, and U.S. Council on Environmental Quality (CEQ) regulations (Title 40, U.S. Code, Parts 1500-1508) for implementing the procedural requirements of the National Environmental Policy Act (NEPA). The finding of this EA is that the Proposed Action will have no significant impact on the human or natural environment. Notification was provided in local newspapers from 24-Aug-04 through 28-Sep-2004 with no response from the public. Therefore, a Finding of No Significant Impact (FONSI) is issued for the Proposed Action and no Environmental Impact Statement (EIS) is required.

## **FINDING OF NO SIGNIFICANT IMPACT**

Based on the evaluation of the attached EA and information discussed above, a Finding of No Significant Impact to the environment is concluded for the Proposed Action, the Alternative Action, and the No Action Alternative and no Environmental Impact Statement (EIS) is required. The Proposed Action is selected as the preferred action for implementation.



Charles H. King  
Chief, Environmental Management Division  
Arnold AFB, TN

Date: 3 Nov 04



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# Acronyms and Abbreviations

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AEDC	Arnold Engineering Development Center
AF	Air Force
AFB	Air Force Base
AFI	Air Force Instruction
AICUZ	Air Installation Compatible Use Zone
ATA	Aerospace Testing Alliance
BMP	Best Management Practice
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
1,1-DCE	1,1-dichloroethene
DNAPL	dense, nonaqueous-phase liquid
DoD	Department of Defense
EA	Environmental Assessment
EIAP	Environmental Impact Analysis Process
EO	Executive Order
EPF	Environmental Planning Function
ERP	Environmental Restoration Program
ESA	Endangered Species Act
FONPA	Finding of No Practicable Alternative
FONSI	Finding of No Significant Impact
gpm	gallons per minute
GWTU	Groundwater Treatment Unit
HDPE	high-density polyethylene
HQ CEV	Headquarters Civil Engineering, Compliance

HWA	Hazardous and Solid Waste Amendments
IEMP	Integrated Ecosystem Management Plan
IPT	Integrated Process Team
IRP	Installation Restoration Program
MAJCOM	Major Command
MCL	Maximum Contaminant Level
µg/cm <sup>3</sup>	Micrograms per cubic centimeter
µg/L	Micrograms per liter
NCCGP	No Consumption-General Public
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPS	Non-point Source
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
OSHA	Occupational Safety and Health Administration
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
ppm	parts per million
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
ROW	right-of-way
SAF	Secretary of the Air Force/Environmental Security
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Office
SMZ	streamside management zone
SWMU	Solid Waste Management Unit



1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
TSCA	Toxic Substance Control Act
TVA	Tennessee Valley Authority
TWQCA	Tennessee Water Quality Control Act
TWRA	Tennessee Wildlife Resources Agency
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
WQA	Water Quality Act

# 1.0 Purpose and Need for Action

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## 1.1 Background

Arnold Air Force Base (AFB) is located in Coffee and Franklin Counties in Middle Tennessee. Arnold AFB is approximately 70 miles southeast of Nashville, the state capital. Positioned near the towns of Manchester, Tullahoma, and Winchester, Arnold AFB is the largest employer in the two-county area (Figure 1-1).

Arnold AFB occupies 39,081 acres including the 3,632-acre Woods Reservoir, which contains approximately 26 billion gallons of water. Woods Reservoir is the source of drinking water for the Base and provides cooling water for facilities in the industrial area. On Arnold AFB, there are 5,785 acres of cultivated pine forests and 23,492 acres of hardwood forests. Grasslands and early-successional habitats in utility rights-of-way (ROWs) occupy 1,479 acres on the installation and provide habitat for numerous rare species (Call, 2003).

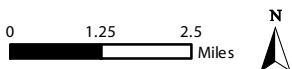
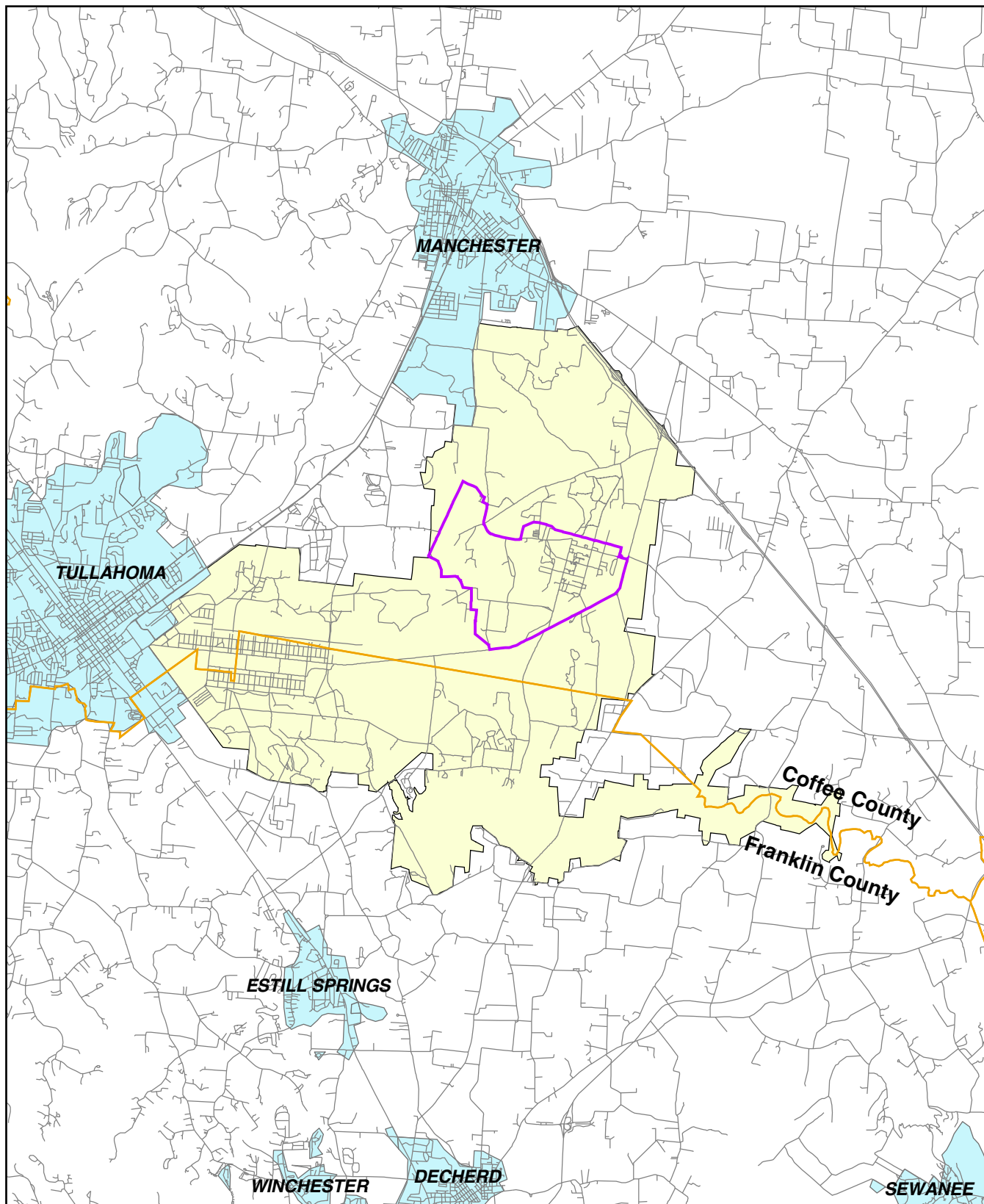
### 1.1.1 Operations

Arnold Engineering Development Center (AEDC), which is located on Arnold AFB, is the most advanced and largest complex of flight simulation test facilities in the world, with 53 aerodynamic and propulsion wind tunnels, rocket and turbine engine test cells, space environmental chambers, arc heaters, ballistic ranges, and other specialized units. Facilities can simulate flight conditions from sea level to altitudes of more than 100,000 feet, and from subsonic velocities to those well over Mach 20. Twenty-seven of AEDC's test units have capabilities unmatched in the world. AEDC has contributed to the development of nearly every top national aerospace program since the 1950s. Customers include the U.S. Air Force (AF), the Army and Navy, the National Aeronautics and Space Administration, the Federal Aviation Administration, private industry, allied foreign governments, and U.S. government and educational institutions.

The Arnold AFB commander is responsible for accomplishing Base's mission. The commander's staff of military personnel and civil service employees is responsible for the overall planning, direction, scheduling, assignment, and funding associated with mission requirements. Under staff supervision, the management, operation, and maintenance of test facilities, real property, and related equipment and utilities are accomplished by contract.

### 1.1.2 History

Arnold AFB is named for the late Henry H. "Hap" Arnold. At the close of WW II, General Arnold, Commander of the Army Air Forces, asked Dr. Theodore von Karman, Chief Scientific Advisor to the AF and one of history's great aeronautical test scientists, to form a Scientific Advisory Group to chart a long-range research and development course for the future AF. Dr. von Karman sent a task force from his newly formed group to Germany to determine how the Germans had made such rapid progress in developing high-performance jet aircraft and rocket-powered missiles. One member of the task force, Dr.



#### LEGEND

- Road Centerline
- County Boundaries
- AEDC Boundary
- Arnold AFB Boundary
- Local Cities



Figure 1-1

#### Arnold Air Force Base and General Vicinity

Construction of SWMU 74 Groundwater Extraction and Conveyance System  
Final Environmental Assessment

Frank Wattendorf, was responsible for surveying wind tunnels and ground test facilities. On his flight home, Dr. Wattendorf wrote a memo that proposed using captured German test facilities to establish a new engineering development center. The new center would consolidate the best civilian and military scientists as well as state-of-the-art test facilities to properly test and evaluate the weapon systems needed to guarantee the United States' superior airpower and thereby the national security. Dr. Wattendorf's "trans-Atlantic memo" became the blueprint for AEDC.

In 1949, Congress authorized \$100 million for the construction of AEDC. A site was selected for the new center at the Army's old Camp Forrest near Tullahoma, and construction began in June 1950. The site was chosen because of the availability of land, water, and power, and to buffer surrounding communities from expected test hazards and noise. Water was needed to cool the rapidly flowing air and hot exhaust gases, and electricity was required to power the huge motordrive systems. The large land acquisition was necessary to accommodate growth for future test facilities and its remote location provided the security required by the size of the installation.

On June 25, 1951, one year after General Arnold's death, President Harry S Truman dedicated the AEDC and renamed it in honor of General Arnold. Anticipating the role this national facility would play in developing key weapon systems, President Truman said, "Never again will the United States ride the coattails of other countries in the progress and development of the aeronautical art. The genius that was General Arnold's is manifest in this installation which now bears his name."

### 1.1.3 Military Mission

The military mission is to support the development of aerospace systems by testing hardware in facilities that simulate flight conditions. The AEDC also conducts a research and technology program to develop advanced test techniques and instrumentation and to support the design of new test facilities. The official mission is:

*To provide our customers with the world's most effective and affordable aerospace ground test and evaluation, and simulation products and services. To ensure AEDC ground test facilities, technologies, and knowledge fully support today's and tomorrow's customers.*

Implicit within this mission is the need to anticipate and plan for growth of the test facilities at AEDC. Ecosystem management provides the framework for the careful assessment of environmental impacts, allowing for the planning and development of new facilities, while at the same time protecting the natural and cultural resources.

The implementation of ecosystem management at Arnold AFB is also in direct support of the overall Department of Defense (DoD) mission. The DoD mission requires that natural resources be managed to provide for the environmental security necessary to support the military mission of national defense. By conserving biodiversity, ecosystem management contributes to national security by helping maintain the natural resources upon which this country's strength depends. Ecosystem management also helps maintain natural landscapes for military training. Combat readiness is founded on the ability of the armed forces to sustain realistic military training now and into the future.

## 1.2 Proposed Action

A large area of groundwater contamination, hereafter referred to as the Plume, containing chlorinated solvents has migrated from multiple sources at Arnold AFB and is discharging to springs and wells located on private property approximately 3 miles from the Base boundary and approximately 6 miles from the source of contamination (Figure 1-2). This area has been designated Solid Waste Management Unit 74 (SWMU 74). Samples from private water-supply wells and springs located along the Plume's path have contained trichloroethene (TCE) at concentrations exceeding the Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCL) of 5 micrograms per liter ( $\mu\text{g/L}$ ). Although a final remedy for groundwater cleanup has not been identified, it is anticipated that TDEC will require extraction of contaminated groundwater with the objective to lower TCE concentrations below the SDWA MCL in groundwater beyond the Base boundary. Other contaminants in the groundwater include: tetrachloroethene (PCE); 1,1-dichloroethene (1,1-DCE); 1,1,1-trichloroethane (1,1,1-TCA); and other volatile organic compounds (VOCs). However, none of these compounds exceed MCLs as the Plume extends beyond the Base boundary.

The Proposed Action is designed to lower the TCE concentration through the extraction of high concentration contaminated groundwater. The groundwater will be conveyed through piping and treated at the J4 Test Cell Groundwater Treatment Unit (GWTU) prior to discharge.

The existing J4 Test Cell GWTU consists of two low-profile air strippers, a carbon adsorption tank, and a pH adjustment tank. Once modified, the system would have sufficient capacity to treat the existing J4 Test Cell dewatering flows plus the additional 100-gallon-per-minute (gpm) flow that would be pumped from the MW-450 area groundwater extraction wells. The carbon adsorption tank is in standby. The VOC removal efficiencies (99%) are very high even without the carbon step. Effluent from the J4 Test Cell GWTU discharges into the Retention Reservoir.

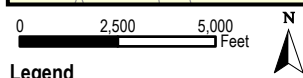
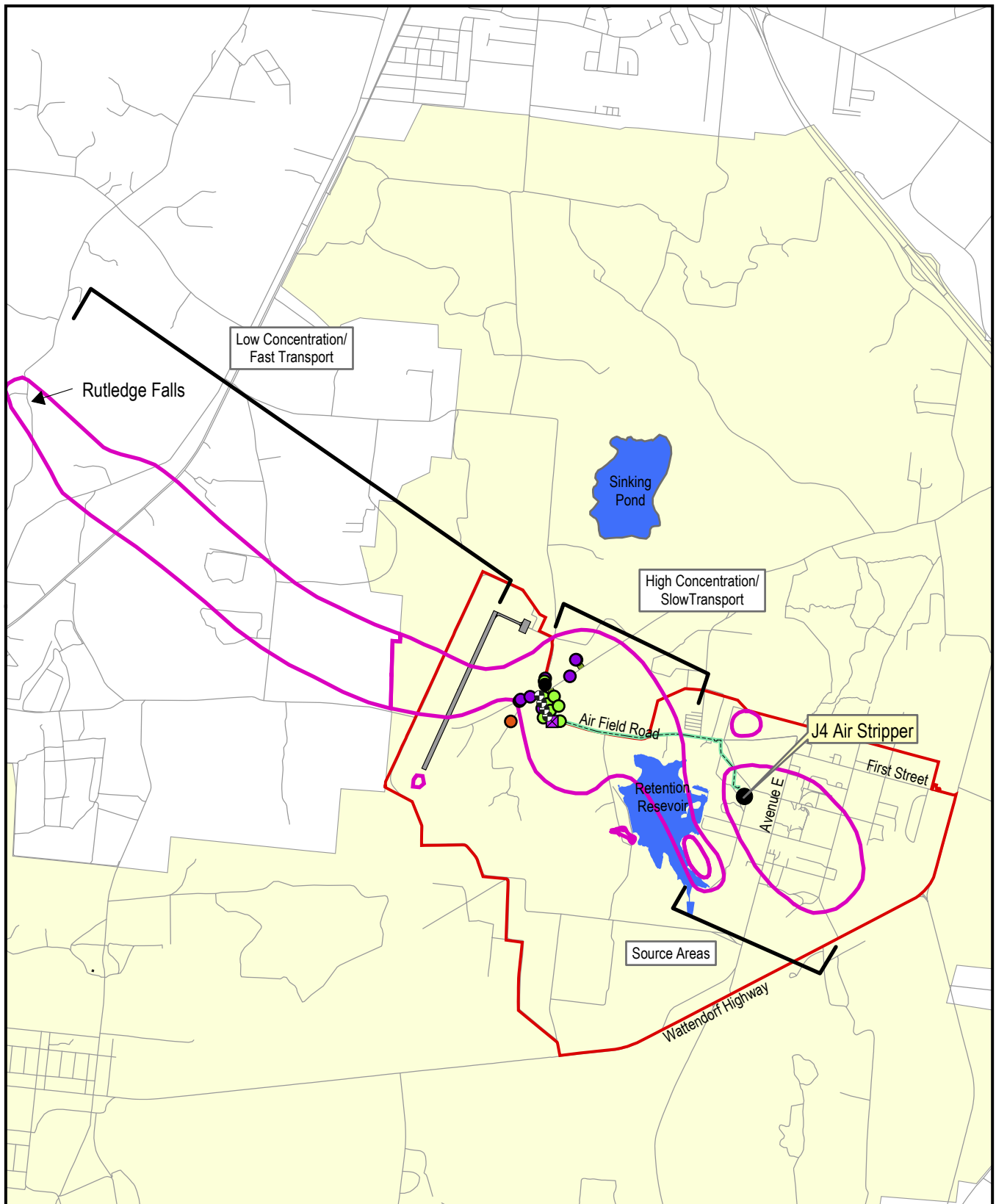
## 1.3 Need for Proposed Action

Implementation of the Proposed Action is needed to protect human health and the environment. Specifically, the Proposed Action is needed to lower the TCE concentrations at the Base boundary as required by TDEC and improve the quality of groundwater that reaches the springs and wells located on adjacent private property.

## 1.4 Objectives of Proposed Action

The short-term objective of the Proposed Action is to reduce concentrations of TCE in groundwater below the MCL as the Plume extends beyond the Base boundary. The long-term objective is, in conjunction with other actions to be taken, to reduce chlorinated solvent concentrations in the entire Plume to below MCLs.





#### Legend

- |   |                             |                     |
|---|-----------------------------|---------------------|
| ● Existing Extraction Well              | ⊕ Proposed Extraction Wells | Arnold AFB Boundary |
| ● Proposed Deep Monitoring Well         | Northwest Plume             | Road                |
| ● Proposed Intermediate Monitoring Well | AEDC Boundary               | Proposed New Road   |
| ● Proposed Piezometer                   | Airfield                    | Water Transfer Pipe |
| ⊠ Proposed Transfer Lift Station        | Reservoirs                  |                     |



Figure 1-2

#### Northwest Plume Discharge Points

Construction of SWMU 74 Groundwater Extraction and Conveyance System  
Final Environmental Assessment

## 1.5 Regulatory Driver

The Plume is being addressed as part of SWMU 74 under the Arnold AFB Hazardous and Solid Waste Amendments (HSWA) Permit. The SWMU is in the Corrective Action Program, with regulatory oversight administered by TDEC. The Proposed Action would be implemented as an interim corrective measure under the Resource Conservation and Recovery Act (RCRA). Arnold AFB is currently completing a RCRA Corrective Measures Study (CMS) for SWMU 74. The Proposed Action is expected to be part of the final corrective measure for SWMU 74.

## 1.6 Related Environmental Documents

The following documents were used in the preparation of this Environmental Assessment (EA):

Peer Review: Interim Corrective Measure, Groundwater Extraction, and Conveyance System – Northwest Plume (Site SS-22), prepared by CH2M HILL for Arnold Engineering Development Center, Arnold Air Force Base, Tennessee. 2004.

CMS Work Plan, SWMU 74, Final Submittal, Contract No. F40650-01-D-0003, CDRL A004, prepared by CH2M HILL for Arnold Engineering Development Center, Arnold Air Force Base, Tennessee. September 2003.

Integrated Ecosystem Management Plan 2003, Arnold Engineering Development Center, Arnold Air Force Base, Tennessee, for Arnold Air Force Base, prepared by Geoff Call, Conservation Biologist, ACS Environmental Services, Conservation.

Historic Building Survey and Evaluation, Arnold Air Force Base, Coffee and Franklin Counties, Tennessee, Draft Report. December 2001, submitted by TRC Garrow Associates, Inc., Atlanta, Georgia, and CH2M HILL, Atlanta, Georgia; M. Todd Cleveland, Architectural Historian and Author, Jeffrey L. Holland, Historian and Author.

## 1.7 Decision to Be Made

A decision is required regarding the impacts of installing a groundwater extraction and conveyance system for the MW-450 area and associated groundwater monitoring system to reduce TCE levels in groundwater leaving the Base at its northwest boundary.

## 1.8 Applicable Regulatory Requirements, Permits, and Coordination

The following regulations, permits or coordination may be applicable to an action alternative as described in this EA:

- The National Environmental Policy Act (NEPA) of 1969

- Title 40 of the Code of Federal Regulations (CFR), Parts 1500-1508 (40 CFR 1500-1508)
- DoD Directive 6050.1 (32 CFR 214)
- Air Force Instruction (AFI) 32-7061
- Executive Order (EO) 11514, Protection and Enhancement of Environmental Quality (amended by EO 11991)
- The Endangered Species Act of 1973 (16 U.S. Code [USC] 1531-1543),
- The Fish and Wildlife Coordination Act, (16 USC 661, et seq.),
- The Migratory Bird Treaty Act (16 USC 701, et seq.)
- The Clean Water Act (CWA) of 1977 and the Water Quality Act (WQA) of 1987 (33 USC 1251 et seq., as amended)
- EO 11990, Protection of Wetlands
- AFI 32-7061
- EO 12372, Intergovernmental Review of Federal Programs,
- The Farmland Protection Act of 1981 (7 USC 4201 et. seq., as amended).
- DoD 4165.57, Air Installation Compatible Use Zone (AICUZ),
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (as amended by the Superfund Amendments and Reauthorization Act [SARA] of 1986)
- The Resource Conservation and Recovery Act of 1976
- The Toxic Substance Control Act (TSCA)
- The National Historic Preservation Act (NHPA) of 1966 (16 USC 470 et seq., as amended)
- The Protection of Historic Properties (36 CFR 800) Act
- The Archeological Resources Protection Act of 1979
- The CWA of 1977 and the WQA of 1987
- EO 11988, Floodplain Management
- The Clean Air Act (CAA) (42 USC 7401 et seq., as amended)
- The Noise Control Act of 1972
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risk

## **1.9 Scope of the Environmental Assessment**

This document was prepared in accordance with the requirements of the NEPA of 1969, the Council on Environmental Quality (CEQ) regulations of 1978, and 32 CFR Part 989. To initiate the environmental analysis, the proponent (Arnold AFB) submitted a Request for Environmental Impact Analysis - AF Form 813 (Appendix A).

### **1.9.1 Issues Eliminated from Detailed Analysis**

The Proposed Action would not have the potential for significant impacts on all resource areas on Arnold AFB. Consequently, the resource areas discussed below have been eliminated from detailed analysis in this document.

#### **1.9.1.1 Air Installation Compatible Use Zone**

The Proposed Action originates near the air field, but is not within any designated AICUZ (Figure 1-3). The activities involved in installing and operating the Proposed Action would not impact air field operations and would not violate any AICUZ restrictions. Therefore, AICUZ was eliminated as an issue warranting further analysis.

#### **1.9.1.2 Land Use**

The Proposed Action would not result in any change in land use on Arnold AFB. Limited clearing may be necessary to install the water line but would not result in substantial land use changes. As there would be no change in land use, land use was eliminated as an issue warranting further analysis.

#### **1.9.1.3 Noise**

The Proposed Action requires the use of heavy equipment to install the water line and pumps would run during operation of the system. Potential noise impacts would be related to water line installation and system operation. Construction would occur only during regular working hours, workers would use proper hearing protection if needed, and the associated noise from equipment would be temporary. There are no sensitive receptors where the groundwater pumps would operate. The J4 Test Cell GWTU includes an air stripper system that already operates and the modifications would not result in an increase in the noise generated during operation. Consequently, noise was eliminated as an issue warranting further analysis.

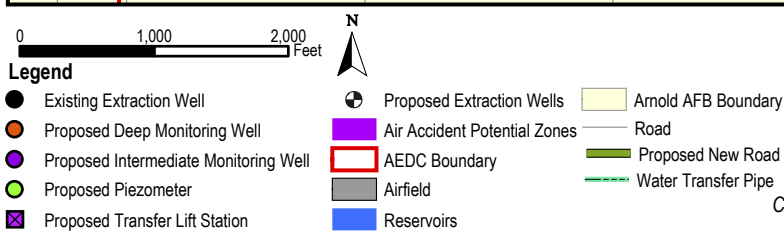
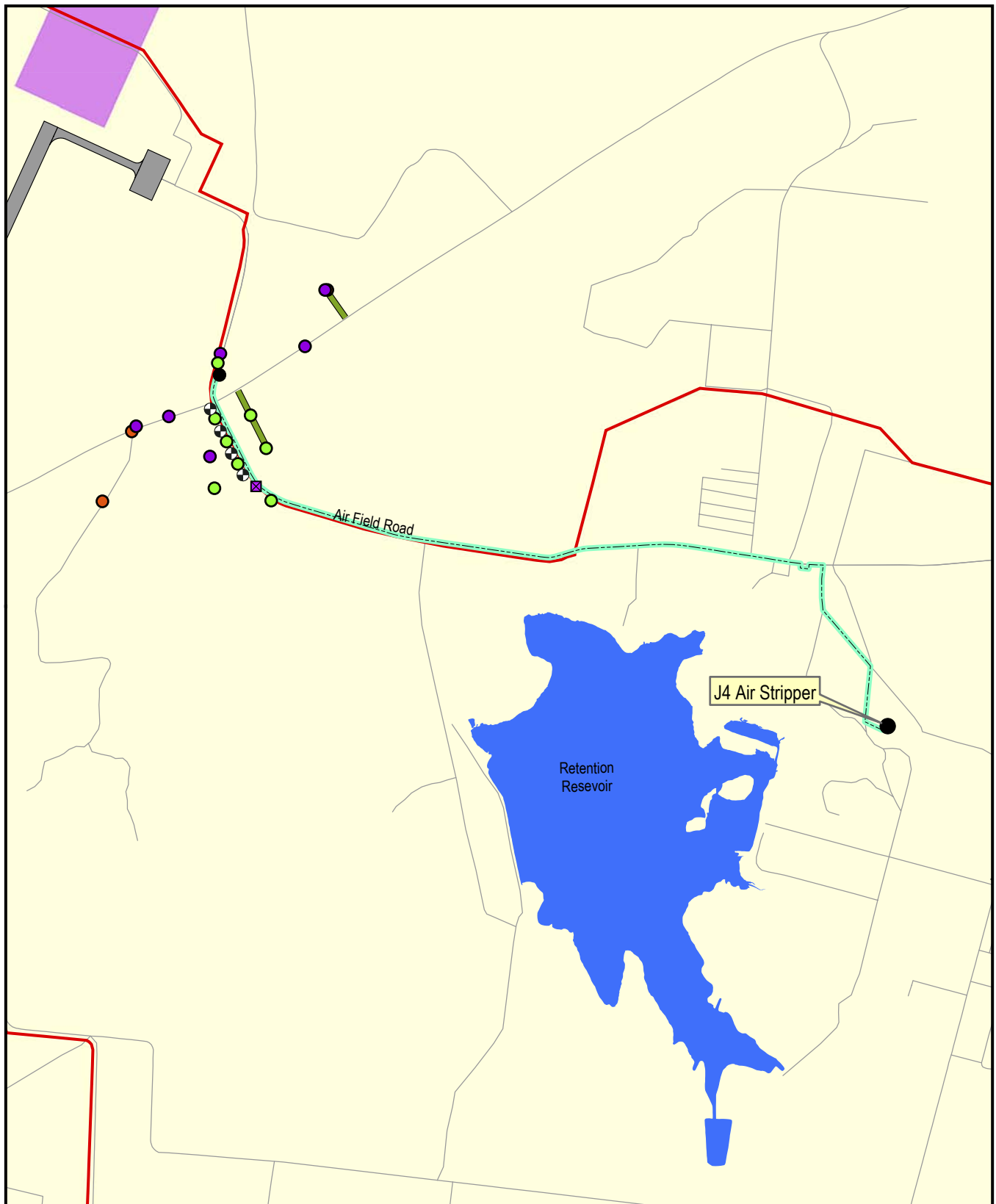


Figure 1-3  
**Location of Proposed  
 Action and Designated AICUZ**  
*Construction of SWMU 74 Groundwater Extraction and Conveyance System  
 Final Environmental Assessment*



#### 1.9.1.4 Safety and Occupational Health

Potential safety and occupational health impacts would be related to construction to install the pumps and water line. Two wells would be installed in an electric transmission ROW. The drilling crew would be required to maintain double the minimum separation distance from the power lines to the drill rig boom to ensure worker safety. The contractor would also be responsible for ensuring that all contractor employees (and subcontractors) comply with all applicable Occupational Safety and Health Administration (OSHA) standards. As a result, there would be no impacts on the safety and occupational health of workers or other persons in the area of the Proposed Action. Therefore, safety and occupational health was eliminated as an issue warranting further analysis.

#### 1.9.1.5 Air Quality

Arnold AFB is located in the Tennessee Valley - Cumberland Mountains Interstate Air Quality Region, which occupies portions of Alabama and Tennessee. Although activities at Arnold AFB result in various sources and volumes of air emissions, the regional air quality is good. Arnold AFB is located in an attainment zone for all pollutants (CH2M HILL, 2002). Air pollutants are emitted from mobile and stationary sources and general maintenance activities, government and privately owned vehicles, jet engine testing, aircraft operations, prescribed burning, wildfires, and mission test and training operations (U.S. Air Force, 2000). TDEC issued AEDC a Title V Operating Permit in May 2002. Currently 26 emission sources are covered under this permit, and all sources are in compliance.

Since Arnold AFB is within an attainment area for all criteria pollutants, major new or modified stationary sources on and in the area of Arnold AFB are subject to Prevention of Significant Deterioration (PSD) review to ensure that these sources are constructed without causing significant deterioration of the air in the area. A major new source is defined as one that has the potential to emit any pollutant regulated under the CAA in amounts equal to or exceeding specific major source thresholds: 100 or 250 tons/year based on the source's industrial category. The groundwater extraction and conveyance system would extract 100 gpm of groundwater with TCE concentrations up to 50,000 µg/L. Emissions from treating those concentrations of TCE at an extraction rate of 100 gpm for an entire year would total 11 tons.

Air quality in a given location is described by the concentration of various pollutants in the atmosphere, generally expressed in units of parts per million (ppm) or micrograms per cubic centimeter (µg/cm<sup>3</sup>). Air quality is determined by the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions. Construction activities under the Proposed Action would result in very limited generation of fugitive dust (particulate matter) and combusive emissions. Particulate matter would occur from trenching to place the water line, but would be limited to normal working hours. Workers would use proper breathing apparatus, as required, while engaged in the construction activities. Combustive emissions from trucks and construction equipment would be very limited and generally occur in areas where sensitive receptors would not be present.

Construction associated with the Proposed Action would be of short duration, approximately 2 months, and any associated air quality issues would be temporary. Because of the relatively small amount of disturbance at any one time, construction of the Proposed Action would not be considered a major new source.

Treatment would be through the existing facility and would not require an additional air permit. Therefore, air quality was eliminated as an issue warranting further analysis.

#### **1.9.1.6 Hazardous Materials**

The Proposed Action would not result in changes in use, handling, or storage of hazardous chemicals on Arnold AFB. Therefore, hazardous chemical use, handling, and storage will not influence the decision to be made. As a result, this issue was eliminated as an issue warranting further analysis.

#### **1.9.1.7 Geology**

No activities conducted under the Proposed Action would affect the underlying geologic features of Arnold AFB. Therefore, geology was eliminated as an issue warranting further analysis.

#### **1.9.1.8 Socioeconomic Factors**

Socioeconomic factors are associated with the human environment, including demographics, community infrastructure and services, employment and wages, recreation, and environmental justice. The Proposed Action would have no significant effect on socioeconomic factors. There would be temporary employment from construction, but these effects would be temporary and minor within the regional economy. No additional staff would be required to operate the treatment and monitoring systems. There would be no increase or loss in permanent staffing positions on Arnold AFB, nor would there be any gain or loss of permanent employment in the surrounding region. The groundwater extraction and conveyance system and associated monitoring would not impact minority or low income population groups.

There would be no change in demand for recreational facilities/opportunities and no change in recreational facilities/opportunities available to the staff of Arnold AFB or residents of the region. The Proposed Action would not cause people to move into or out of the area. With no change in population, the Proposed Action would not result in a change in demand for community infrastructure and services (fire, police, medical, housing, schools, etc.). Therefore, socioeconomics was eliminated as an issue warranting further analysis.

### **1.9.2 Issues Studied in Detail**

The resource areas below are discussed in detail in this document.

- Geomorphology
- Hydrology
- Water Quality
- Installation Restoration Program (IRP)
- Non-Sensitive Biological Resources

- Sensitive Species
- Sensitive Habitats
- Cultural Resources
- Traffic Flow and Utility Infrastructure

## 1.10 Document Organization

This EA follows the organization established by the CEQ regulations (40 CFR, Parts 1/500-1508). This document consists of the following sections:

- 1.0 Purpose and Need for Action
  - 2.0 Description of the Proposed Action and Alternatives
  - 3.0 Affected Environment
  - 4.0 Environmental Consequences
  - 5.0 Plan, Permit, and Management Requirements
  - 6.0 List of Preparers
  - 7.0 List of Contacts
  - 8.0 References
- Appendices

## 2.0 Description of Proposed Action and Alternatives

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As required by federal regulation, this EA addresses the possible environmental impacts of the Proposed Action and a No-Action Alternative. This section provides a summary of the issues and potential impacts associated with the Proposed Action and No-Action Alternative.

### 2.1 Proposed Action (Preferred Alternative)

The Plume contains chlorinated solvents that have migrated from multiple sources at Arnold AFB and has been designated SWMU 74. The Plume discharges to springs located on private property approximately 3 miles from the Base boundary and approximately 6 miles from the source of contamination. The Plume follows a complex groundwater flow that passes through porous media near the source of contamination and through fractured limestone further downgradient. The Plume is fairly well defined to Rutledge Falls (Figure 1-2). Near the source area, TCE concentrations have been detected up to 50,000 µg/L, and are likely fed by residual dense, nonaqueous-phase liquid (DNAPL) remaining from releases that occurred years ago. Between the source area and a location approximately 3 miles downgradient, the Plume extends over a wide path along the top of the limestone bedrock, with TCE concentrations as high as 200 to 300 µg/L. Near the Base boundary, the Plume enters fractured bedrock and follows a fairly narrow flow path to spring discharge points near Rutledge Falls.

Concentrations of TCE in the bedrock portion of the Plume and the location where the springs exit the ground range are as high as 5 to 10 µg/L. The total mass of TCE in the Plume is estimated to be 6,000 pounds. Samples from private water-supply wells and springs located along the Plume's path have contained TCE at concentrations that exceed the SDWA MCL of 5 µg/L. The Proposed Action is designed to reduce levels of TCE in groundwater extending beyond the northwestern Base boundary to below the SDWA MCL.

Arnold AFB proposes to intercept the Plume and extract groundwater for treatment through an air stripper (Figure 2-1). The purpose of the extraction wells would be to intercept the Plume and remove sufficient contaminant mass to lower downgradient concentrations below the drinking water MCLs. After treatment, the water would be discharged into the Retention Reservoir. Intermediate and deep groundwater monitoring wells would be installed along the Plume (Figure 2-1). The Proposed Action includes installing a total of 26 wells and piezometers. The major elements include:

- Groundwater extraction system consisting of five wells along Air Field Road approximately 3,700 feet (0.7 mile) from the air field. Four new extraction wells and the existing extraction well 705 would be used.

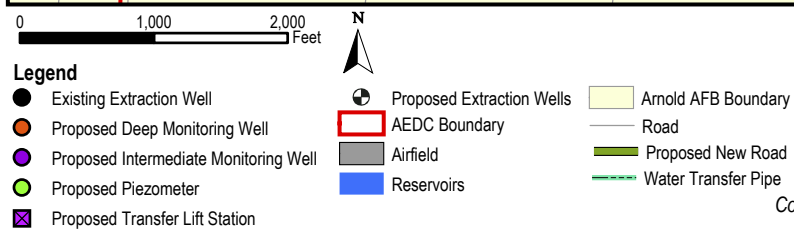
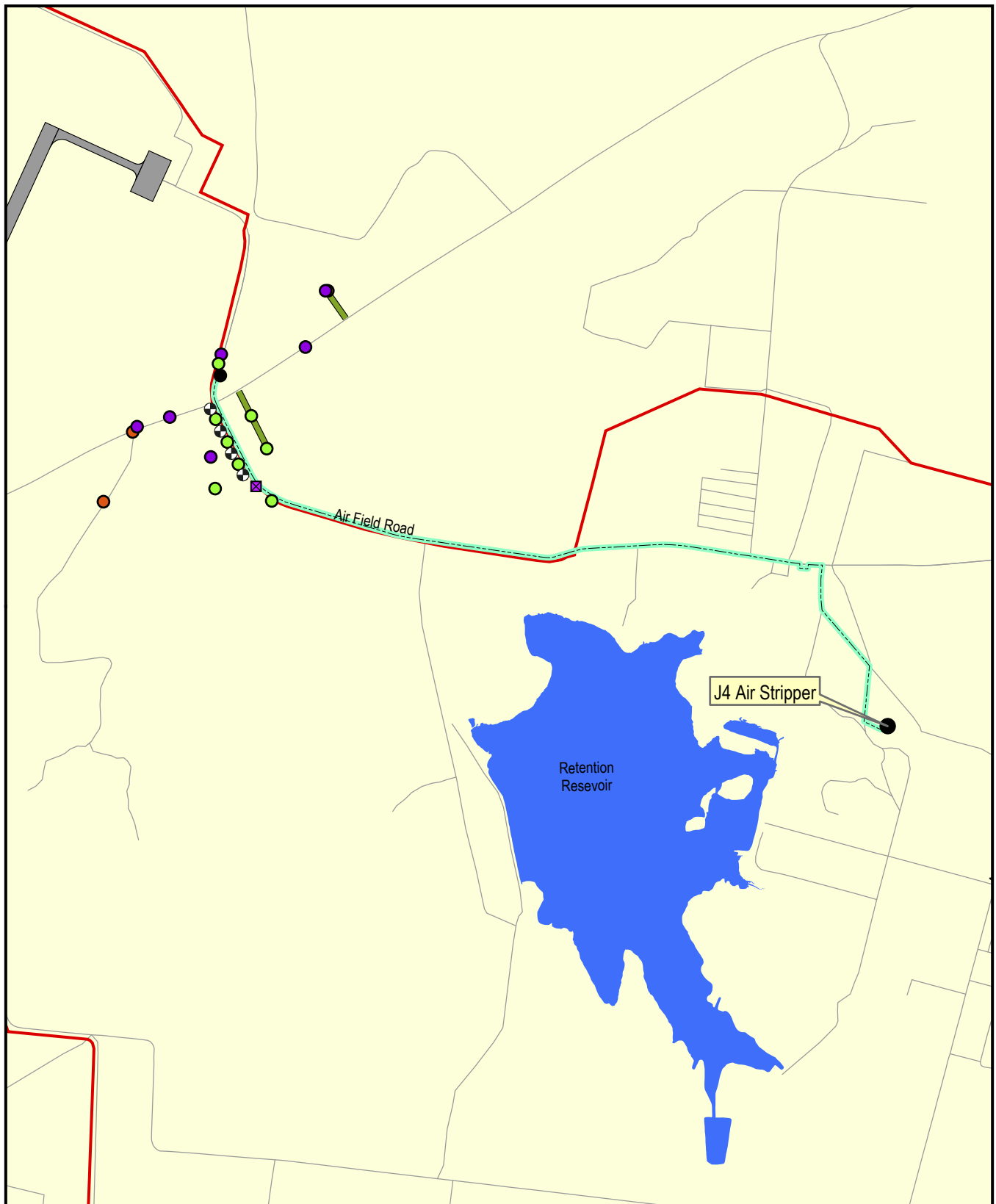


Figure 2-1  
**Location of Proposed Action**  
 Construction of SWMU 74 Groundwater Extraction and Conveyance System  
 Final Environmental Assessment



- Transfer lift station and high-density polyethylene (HDPE) transmission water line to convey contaminated groundwater to the existing J4 Test Cell GWTU.
- Modifications to the existing J4 Test Cell dewatering system to provide a steady-state flow to the GWTU.
- Installation of a groundwater monitoring system including; 12 wells (4 intermediate wells and 4 nested pairs of intermediate and deep wells), and 10 piezometers (5 pairs of intermediate and deep piezometers).
- Construction of new gravel roads to three monitoring well/piezometer locations to allow installation and monitoring of the wells.
- Discharge through the J4 Test Cell GWTU, which is permitted by TDEC under the NPDES Permit No. TN0003751.

The J4 Test Cell GWTU consists of two low-profile air strippers, a carbon adsorption tank, a pH adjustment tank, and a discharge to the Retention Reservoir. The J4 Test Cell GWTU would have sufficient capacity to treat the existing J4 Test Cell dewatering flows plus the additional 100-gpm flow that would be supplied by the MW-450 area groundwater extraction and conveyance system after the proposed modifications are made. The configuration changes to the J4 Test Cell dewatering system include the following:

- Three new pumps of approximately 150-gpm capacity, with piping modifications to the lift station
- Electrical/control modification for pumps and control features at the J4 Test Cell GWTU
- Valving/controls on the two 2,500-gpm pumps to redirect flow into the J4 Test Cell

Effluent from the J4 Test Cell GWTU would continue to discharge into the Retention Reservoir after the modifications.

## 2.2 No-Action Alternative

The No-Action Alternative would be to not treat the groundwater Plume at MW-450 and continue allowing groundwater with elevated levels of TCE to extend beyond the Base boundary and occur in springs and drinking water wells.

### 2.2.1 Alternatives Considered but Not Carried Forward

NEPA requires that the Proposed Action, No-Action Alternative, and any other practicable alternatives be considered in the analysis. In developing a method for treating the Plume, Arnold AFB considered multiple treatment approaches. These methods were analyzed in separate studies for treatment feasibility and relative costs (CH2M HILL, 2004).

The Proposed Action was selected after considering several alternatives that employed different technologies, including in situ chemical oxidation, in situ reductive dechlorination using zero-valent iron, and enhanced bioremediation using a substrate such as edible oil or molasses. These technologies were considered impracticable because of costs, technical feasibility and effectiveness, resource protection, and/or site conditions.

Providing a public water supply to users located downgradient of the Base property boundary was also considered. However, this alternative does not meet the regulatory objective of reducing concentrations to MCL at the Base boundary and was considered impracticable to meet the project purpose on that basis. Additionally, providing a public water supply would involve relatively high costs and would not provide adequate controls to ensure that offsite users would not continue to use or drink potentially contaminated well water.

All other treatment options were determined to be inferior to the Proposed Action. For other options, it was determined that treatment was less effective, more costly, or less reliable than the Proposed Action. Therefore, no other action alternatives are considered practicable and carried forward for analysis.

## 2.2.2 Comparison of Alternatives Carried Forward

The Proposed Action and the No-Action Alternative are compared in Table 2-1.

TABLE 2-1

Comparison of Impacts of Considered Alternatives

*Construction of SWMU 74 Groundwater Extraction and Conveyance System EA*

Resource Area	Proposed Action	No-Action Alternative
Geomorphology	Limited soil disturbance from installation of water line and monitoring wells. Placement of gravel to create three road beds. Impacts would be temporary and minor.	No Impacts.
Hydrology	Removal of 100 gpm of groundwater and addition of 100 gpm of surface water to the Retention Reservoir. Minor impact. Inter-basin transfer of 100 gpm. No impact based upon discharge location.	No Impacts.
Water Quality	Positive impact as concentrations of TCE in groundwater from the Plume would be reduced below MCL in areas beyond the Base boundary.	No change from current conditions. TCE levels in off-Base groundwater fed by the Plume would remain above the MCL.
Non-sensitive Biological Resources	No Impacts.	No Impacts.
Sensitive Species	No Impacts. Some monitoring wells and one access road would be located in habitat suitable for Eggert's sunflower, but coordination with Aerospace Testing Alliance (ATA) Natural Resource staff would avoid impacts on the species.	No Impacts.
Sensitive Habitats	No Impacts. Some monitoring wells and one access road would be located in habitat suitable for Eggert's sunflower, but coordination with ATA Natural Resource staff would avoid impacts on the species.	No Impacts.
Cultural Resources	Shovel tests were conducted in the ROWs for the 2 proposed roads. No cultural resources were found.	No Impacts.
Installation Restoration Program	The Proposed Action is part of the IRP and would place Arnold AFB in compliance with requirement to lower TCE concentrations in the Plume below the MCL.	Program would not meet the anticipated groundwater cleanup level under the RCRA corrective action program.

## 3.0 Affected Environment

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### 3.1 Physical Resources

Physical resources include the atmosphere (air quality, climate, and meteorology), geomorphology (landforms, terrain, topography, and soils), geology (underlying land formations), and hydrology (surface- and groundwaters, including water quality). Analyses in this area focus on identifying those resources that would be impacted by the alternatives, and the resulting consequences to the quality and utility of those resources. Impacts on geology have been eliminated from further analysis (as discussed in Section 1). However, analysis of potential impacts on geomorphology is included.

#### 3.1.1 Geomorphology

Geomorphology, as discussed here, refers to landforms, slopes (topography/relief), and soils at the Arnold AFB area. Analysis of this feature helps to establish the relationships between various elements of the environment (geology, hydrology, vegetation, and wildlife). The topography at Arnold AFB ranges from relatively flat with poor surface drainage in the northern portion of the installation to moderately rolling with defined stream channels in the southern section.

Arnold AFB lies within the eastern part of the Highland Rim physiographic region of Tennessee (Miller, 1974). It is bounded to the east by the Cumberland Plateau, which is an escarpment rising to an elevation of 1,000 feet above the Highland Rim and to the west by a well-dissected escarpment dropping off to the Central Basin physiographic region. Between these two escarpments, the Highland Rim region is a bench approximately 25 miles wide. A major surface water drainage divide bisects Arnold AFB in a southwest-to-northeast trending line. Tributaries of the Duck River drain the area to the northwest, and tributaries of the Elk River drain the area to the southeast. Elevations range from about 1,100 feet above sea level at the drainage divide to 890 feet above sea level in the valleys. In the areas north and northeast of Arnold AFB, there are many swamps and internally drained depressions. Stream channels there are poorly defined and stay dry through much of the summer and fall (Haugh and Mahoney, 1994). The southwestern part of Arnold AFB has well-defined drainage channels, particularly Spring Creek, which at its lower reaches is well-incised and supports a sustained baseflow (Haugh and Mahoney, 1994).

The stratigraphic column underlying Arnold AFB consists of fractured carbonate rocks covered by regolith (Wilson, 1976). The regolith is derived from the weathering of the Mississippian-age St. Louis and Warsaw Limestones and ranges from 10 to 100 feet thick. It is primarily composed of clayey chert rubble with some silt and sand. A typical sequence of regolith at Arnold AFB includes finer-grained clays, sands, and silts at ground surface with increasing amounts of chert rubble occurring with depth (Burchett, 1977). The bedrock underlying the regolith is the Mississippian Fort Payne Formation, which is composed primarily of chert and cherty limestone. At Arnold AFB, this formation ranges in thickness from 20 to 230 feet. The upper portion of the bedrock is highly weathered, with many

fractures and solution openings. The lower portion of the bedrock has few fractures (Aycock and Haugh, 1999). Underlying the Fort Payne Formation is the Chattanooga Shale.

The regional geologic dip of these units is approximately 10 to 20 feet per mile to the east and southeast. However, there is a local dome-shaped geologic structure beneath the Arnold AFB area which may have formed in response to regional tectonic stresses (Haugh and Mahoney, 1994). The axis of this dome generally follows the surface water drainage divide. Vertical and near-vertical fractures exist in the bedrock beneath Arnold AFB, perhaps formed by the same tectonic pressures.

Groundwater beneath the Arnold AFB area occurs within the regolith, and to a more limited extent within the bedrock. The main water-bearing unit in the area occurs within the chert rubble unit at the base of the regolith just above the bedrock and the solution-openings in the upper portion of the bedrock (Aycock and Haugh, 1999). Locally, vertical fractures in the bedrock may influence groundwater flow patterns (Haugh and Mahoney, 1994). The lower portion of the Fort Payne bedrock has few fractures and low yields of water (Haugh and Mahoney, 1994). The Chattanooga shale is considered to be the base of the fresh groundwater system in the area (Haugh and Mahoney, 1994; Haugh, 1996). A groundwater divide bisects Arnold AFB and generally corresponds to the surface water drainage divide.

A silty mantle of loess underlain by residual clays or cherty clay covers most of the region. Where the mantle has been thinned by erosion the clay is red, which is typical of limestone soils with high iron oxide content. Some areas within Arnold AFB have undergone significant earth moving activities, which may have significantly altered natural surface soil conditions. There is good to moderate drainage in the region.

Soils on Arnold AFB primarily belong to the Dickson-Mountview-Guthrie Association and consist chiefly of ultisols developed on a thin (<4.9 feet) silty mantle overlying cherty limestone residuum (Love et al., 1959; Springer and Elder, 1980; Smalley, 1983; Patterson, 1989). The Dickson silt loam and Mountview silt loam are the most important soils on well-drained slopes and ridges. Both of these soils are strongly to very strongly acidic, moderately permeable in their surface horizons, and low in fertility. They differ primarily in that the Dickson soil has a discontinuous fragipan (relatively impermeable layer) at the base of the silty upper mantle that restricts subsoil drainage (Love et al., 1959). The fragipan layer contributes to the patterns of seasonal flooding observed at Arnold AFB by restricting drainage during the wet winter months and by limiting the upward movement during the dry summer months.

Guthrie silt loam is the characteristic soil of headwater wetlands in The Barrens. This soil is developed on parent materials similar to those of the Dickson and Mountview soils and contains a discontinuous fragipan. It is strongly to very strongly acidic and low in fertility. The Guthrie silt loam differs from the Dickson silt loam primarily in its poor drainage and landscape position. The most extensive occurrences of Guthrie silt loam occupy the bottoms of intermittent headwater streams and sinkholes. Small patches of this soil occur as wet inclusions within the Dickson silt loam and other upland soils on ridgetops. Other soils within the association are the moderately well-drained Sango silt loam and the somewhat poorly drained Taft (formerly Lawrence) silt loam (Call, 2003).

The Dickson-Baxter-Greendale soil association also occurs on Arnold AFB. It is an extensive soil association on the Highland Rim and occupies 13.3 percent of Coffee County. Typical relief for this association includes large, almost level or undulating areas with steeper slopes near drainageways. The drainage pattern is dendritic, but streams are neither numerous nor well-entrenched. Imperfectly and moderately drained soils predominate (United States Department of Agriculture [USDA] Soil Conservation Service, 1949).

Dickson, Baxter, and Greendale soils occupy most of the association, with Lawrence, Guthrie, Ennis, and Lobelville soils also present. A small amount of Montview soil also is found in the area. Dickson soils occur primarily on undulating or nearly level to depressed areas. The upper layers of these soils are generally free of chert, stones, or gravel, and the subsoils are compact and relatively impervious. Mountview soils are chert-free on the undulating uplands. Baxter soils are located in steeper areas along the larger drainages. The cherty Greendale soils are on young, alluvial-colluvial deposits at the base of slopes occupied by Baxter soils and along intermittent streams. Lobelville and Ennis soils occur in long narrow areas on first bottoms along streams (USDA Soil Conservation Service, 1949).

### 3.1.2 Hydrology

Hydrological features include surface waters (lakes, rivers, streams, and springs) and groundwater. Arnold AFB lies within the Duck River and the Elk River basins. The drainage divide between these two watersheds extends southwest to northeast through the AEDC Industrial Area (Figure 3-1). The Duck River basin lies to the north of the divide and receives drainage from Hunt, Huckleberry, Wiley, Crumpton, and Bobo Creeks and the Hickerson Spring Branch. The Elk River basin is to the south of the divide and collects surface drainage, primarily from Bradley, Brumalow, and Rowland Creeks. Smaller creeks such as Dry Creek, Hardaway Branch, Saltwell Hollow Creek, Spring Creek, and Poorhouse Creek also contribute to the Elk River (Call, 2003).

Regional groundwater resources include the Mississippi Carbonate (karst) aquifer (recently named Highland Rim aquifer). This aquifer consists of flat-lying carbonate rocks of Mississippian age and underlies the Highland Rim physiographic province. The western part of this area is dissected and hilly to steep, whereas land in the eastern, northern, and southern parts of this province is predominantly undulating. The bedrock formations have a deep (up to 100 feet thick) chert regolith that stores groundwater and releases it to bedrock openings. There are fractures in the bedrock, which permit rapid transmission of water. Well yields commonly range from 5 to 50 gallons per minute (TDEC, 2002).

Karst areas are characterized by sinkholes, springs, disappearing streams and caves, and by rapid, highly directional groundwater flow in discrete channels. Since water can travel rapidly over long distances through conduits that lack natural filtering processes of soil and bacteria, karst systems are easily contaminated.

Floodplains have been defined at several locations on Arnold AFB (Figure 3-2). These areas are located near Woods Reservoir and Sinking Pond.

The climate of the eastern Highland Rim varies by season, with generally mild winters and warm summers. Rainfall averages between 50 and 55 inches per year and is heaviest in late winter and early spring. The average yearly temperature is about 60 degrees Fahrenheit (Smith, 2004). Precipitation is fairly evenly distributed throughout the year, with slightly

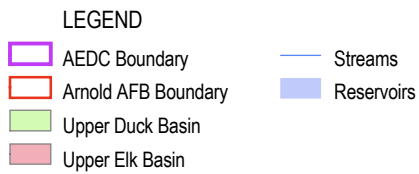
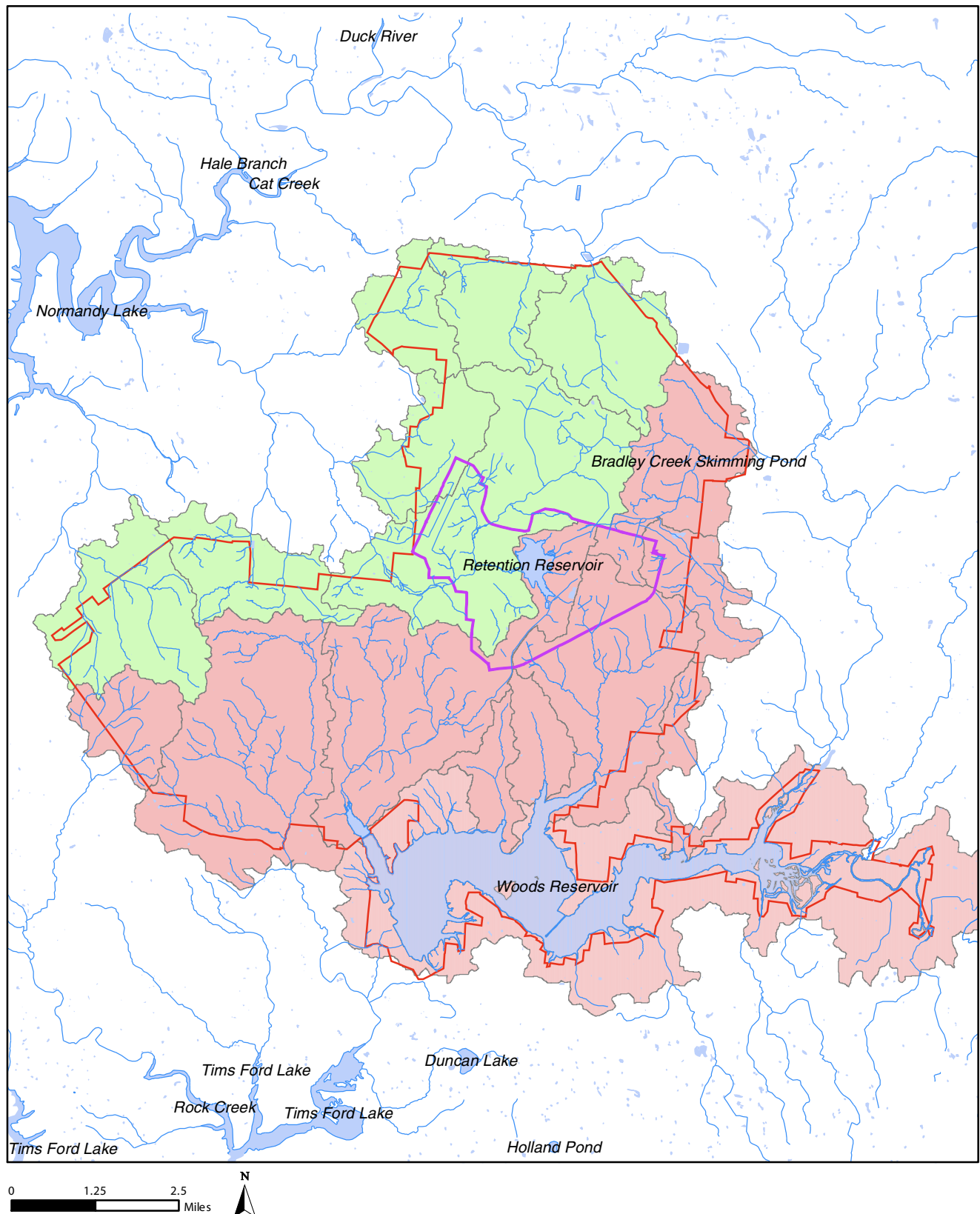
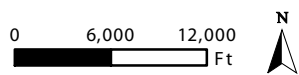
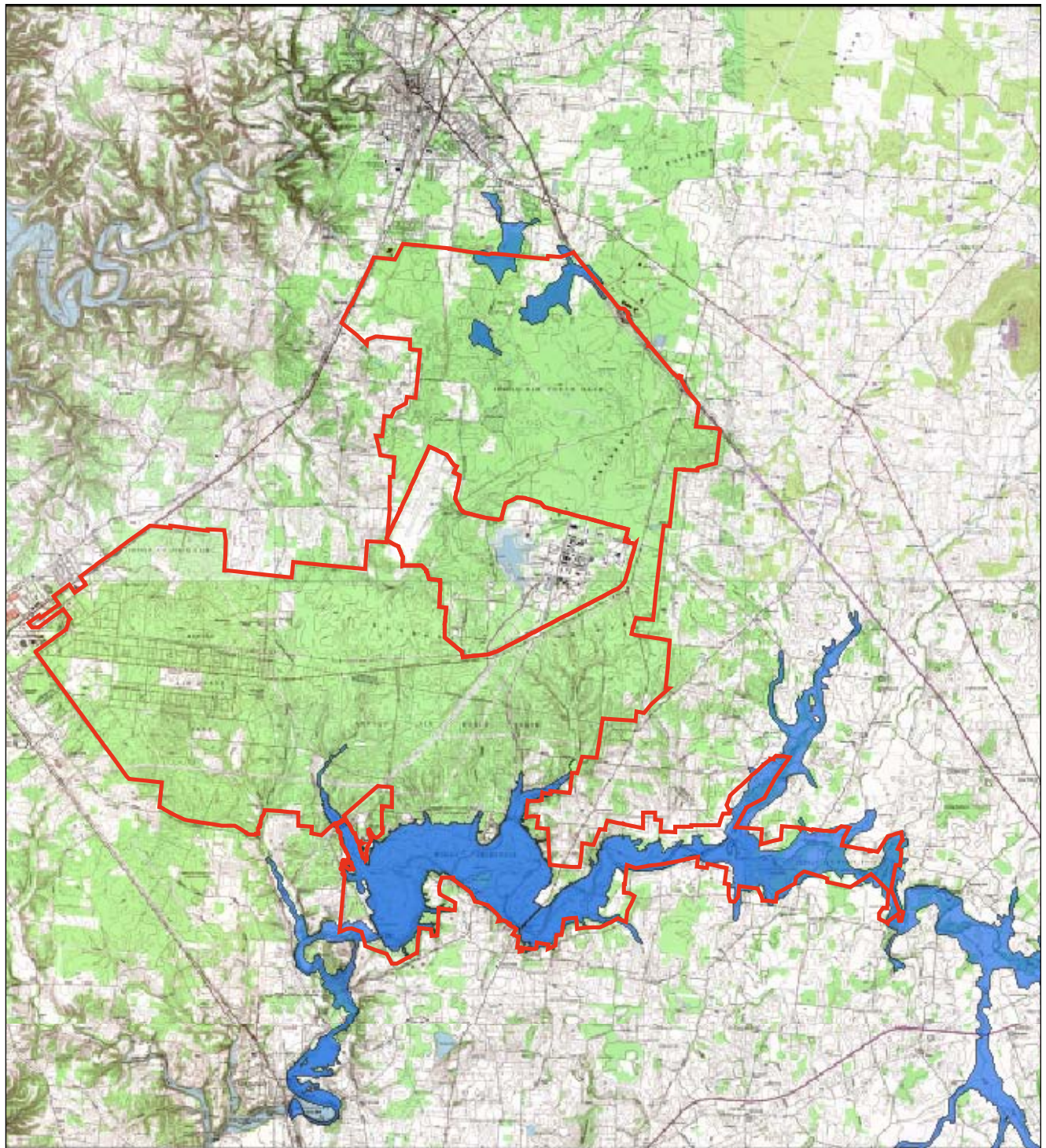


Figure 3-1  
**Surface Waters and Watersheds on Arnold Air Force Base**  
 Construction of SWMU 74 Groundwater Extraction and Conveyance System  
 Final Environmental Assessment





- LEGEND
- AEDC Boundary
  - Floodplain Area



Figure 3-2

**Floodplains Located on Arnold Air Force Base**  
 Construction of SWMU 74 Groundwater Extraction and Conveyance System  
 Final Environmental Assessment

less in fall and slightly more in winter. August is typically the driest month (3.4 inches of precipitation) and February has the highest average precipitation (6.8 inches) ([www.noaa.gov](http://www.noaa.gov)).

### 3.1.3 Water Quality

Arnold AFB is located in two watersheds, with the divide between the Upper Elk River and the Duck River basins generally following the middle of the Base (Figure 3-1). Within the Duck River basin in the vicinity of the Proposed Action, there are only two streams that do not fully meet their designated uses. Both the Duck River and the Little Duck River have elevated bacteria levels near the City of Manchester, attributed to failing sewage collection systems within the city and general urban runoff (TDEC, 2002b).

The Upper Elk basin has 12 water bodies on the final version of the 2002 Section 303(d) list, which was issued in January 2004 (United States Environmental Protection Agency [USEPA], 2004a). Woods Reservoir located in the project area is listed as not supporting its designated uses because of PCB impairment of sediments resulting from historical PCB releases from AEDC into Woods Reservoir. A No Consumption-General Public (NCGP) fishing advisory has been issued for catfish (TDEC, 2002b).

Groundwater in the project area and extending northwest from the Base contains contaminants from various sources. Groundwater in the Plume contains TCE at concentrations above the SDWA MCL of 5 µg/L. The Plume also contains PCE; 1,1-DCE; 1,1,1-TCA; and other VOCs, but these other compounds do not exceed MCLs beyond the Base boundaries.

## 3.2 Installation Restoration Program (IRP)

Arnold AFB has an active IRP that is designed to address environmental contamination from historical releases and protect human health. Twenty-six IRP sites have been identified on Arnold AFB and 11 of these have been closed after determinations of no further action required.

SWMU 74 is under investigation and evaluation at this time. It is anticipated that multiple actions will be required to address all of the issues at SWMU 74 (CH2M HILL, 2003; 2004).

## 3.3 Biological Resources

Biological resources include the native and introduced terrestrial plants and animals around Arnold AFB. The land areas at Arnold are home to unusually diverse biological resources including several sensitive species, habitats, and wetlands. Arnold AFB developed a system of ecological associations based on floral, faunal, and geophysical characteristics. These ecological associations are described in the Arnold AFB Integrated Ecosystem Management Plan (IEMP) (Call, 2003).



### 3.3.1 Wildlife Species

Wildlife species at Arnold AFB are those common to the central southeastern United States. A literature review was conducted to identify representative common species of mammals, reptiles, amphibians, and birds (Table 3-1).

TABLE 3-1  
Common Wildlife Species Occurring in Arnold AFB Vicinity  
*Construction of SWMU 74 Groundwater Extraction and Conveyance System EA*

Common Name	Scientific Name
<b>Bats</b>	
Little brown bat	<i>Myotis lucifugus</i>
Northern myotis	<i>Myotis septentrionalis</i>
Red bat	<i>Lasiurus borealis</i>
Eastern pipistrelle	<i>Pipistrellus subflavus</i>
Big brown bat	<i>Eptesicus fuscus</i>
<b>Rodents</b>	
Eastern chipmunk	<i>Tamias striatus</i>
Groundhog	<i>Marmota monax</i>
Eastern gray squirrel	<i>Sciurus carolinensis</i>
Fox squirrel	<i>Sciurus niger</i>
American beaver	<i>Castor canadensis</i>
White-footed mouse	<i>Peromyscus leucopus</i>
Woodland vole	<i>Microtus pinetorum</i>
Raccoon	<i>Procyon lotor</i>
Virginia opossum	<i>Didelphis virginiana</i>
Smokey shrew	<i>Sorex fumeus</i>
Southeastern shrews	<i>Sorex longirostris</i>
Least shrew	<i>Cryptotis parva</i>
Eastern mole	<i>Scalopus aquaticus</i>
Coyote	<i>Canis latrans</i>
Red fox	<i>Vulpes vulpes</i>
Gray fox	<i>Urocyon cinereoargenteus</i>
Long-tailed weasel	<i>Mustela frenata</i>
Striped skunk	<i>Mephitis mephitis</i>
Bobcat	<i>Lynx rufus</i>
White-tailed deer	<i>Odocoileus virginianus</i>
Eastern cottontail	<i>Silvilagus floridanus</i>
<b>Amphibians</b>	
Eastern newt	<i>Notophthalmus viridescens</i>
Spotted salamander	<i>Ambystoma maculatum</i>
Two-lined salamander	<i>Eurycea bislineata</i>
Bull frog	<i>Rana catesbeiana</i>
Green frog	<i>Rana clamitans</i>
Pickrel frog	<i>Rana palustris</i>
Southern leopard frog	<i>Rana sphenoccephala</i>
Spring peeper	<i>Hyla crucifer</i>
Chorus frog	<i>Pseudacris triseriata</i>

TABLE 3-1

Common Wildlife Species Occurring in Arnold AFB Vicinity  
 Construction of SWMU 74 Groundwater Extraction and Conveyance System EA

Common Name	Scientific Name
American toad	<i>Bufo americanus</i>
Woodhouse's toad	<i>Bufo woodhousei</i> ).
<b>Reptiles</b>	
Common snapping turtle	<i>Chelydra serpentina</i>
Mud turtle	<i>Kinosternon subrubrum</i>
Musk Turtle	<i>Sternotherus odoratus</i>
Red-eared slider	<i>Trachemys scripta</i>
Eastern box turtle	<i>Terrapene carolina</i>
Eastern spiny softshell	<i>Apalone spinifera</i>
Eastern fence lizard	<i>Sceloporus undulatus</i>
Six-lined racerunner	<i>Cnemidophorus sexlineatus</i>
Five-lined skink	<i>Eumeces fasciatus</i>
Broad-headed skink	<i>Eumeces laticeps</i>
Black racer	<i>Coluber constrictor</i>
Corn snake	<i>Elaphe guttata</i>
Black rat snake	<i>Elaphe obsoleta</i>
Common kingsnake	<i>Lampropeltis getulus</i>
Northern water snake	<i>Nerodia sipedon</i>
Rough green snake	<i>Opheodrys aestivus</i>
Common garter snake	<i>Thamnophis sirtalis</i>
Copperhead	<i>Agkistrodon contortix</i>

Mammal species from Lamb 2004a, Mullen et al. 1995; Bailey et al. 2003; J.W. Lamb personal communication, 2004.

Amphibian species from Mullen et al. 1995; J.W. Lamb personal communication, 2004.

Reptile species from Mullen et al. 1995; Bailey et al. 2003; J.W. Lamb personal communication, 2004.

A study was conducted in 2000 to document bird use of wetland flats and depressions (Roberts et al., 2001). This study identified 59 species of birds, including 34 neotropical migrant species, using wetlands during the breeding season. Forty-six bird species were identified using the wetland flats and depressions in winter. A list of the species identified during this study is provided in the report (Roberts et al., 2001). Eighty-six bird species have been documented breeding at Arnold AFB (Lamb 1999, 2000, 2001, 2002, 2003a, 2004a). Including summer residents, migrants, and wintering species, a total of 226 species have been documented at Arnold AFB (J.W. Lamb, unpublished data).

In the 1950s, a comprehensive game management plan was initiated to increase wildlife populations so that reasonable harvests by the public would be possible. From 1954 to 1964, over 17,000 quail, 6,000 pheasant, 64 deer, and 21 turkeys were stocked. In 1974, the stocking of Canada goose began, with 53 geese stocked on the Retention Pond. An additional 50 geese were stocked in 1975. There are now abundant populations of deer, quail, geese, and turkeys on Arnold AFB. Since deer hunting was initiated in 1965, a total of 21,308 deer have been harvested to date (Call, 2003).

### 3.3.2 Plant Species

Arnold AFB lies in the heart of The Barrens region of the eastern Highland Rim. “Barrens” most often refers to grasslands similar to the Midwestern tallgrass prairie but may also be used to describe openings with scattered trees that may resemble savanna or shrubland. Present vegetation on Arnold AFB is predominantly upland and swamp oak forest. Of the forested areas, 23,492 acres are in native hardwoods and 5,785 acres are in planted, non-native pines. Forested areas are most frequently characterized by closed canopies dominated by various oaks. Dry sites are dominated by post oak (*Q. stellata*), blackjack oak (*Q. marilandica*), scarlet oak (*Q. coccinea*), southern red oak (*Q. falcata*), and black oak (*Q. velutina*). Wet sites are dominated by white oak (*Q. alba*), willow oak (*Q. phellos*), water oak (*Q. nigra*), and overcup oak (*Q. lyrata*). Understories include a wide variety of species including dogwoods (*Cornus* spp.), maples (*Acer* spp.), sassafras (*Sassafras albidum*), sourwood (*Oxydendrum arboreum*), and blueberries (*Vaccinium* spp.).

Numerous wetlands occur across the Base, with prevailing vegetation ranging from grassland to closed-canopy forest. Several hundred acres of open, prairie-like Barrens occur primarily near the air field and along powerline and railroad ROWs. The flora of the region has long been noted for its unusual Coastal Plain disjuncts. Coastal Plain disjuncts are species that normally occur only in the Atlantic or Gulf coastal plains. These species are found nowhere else in Tennessee. To date, over 900 vascular plant species have been recorded on the Base (Call, 2003). The Nature Conservancy and the Tennessee Division of Natural Heritage classified and mapped the vegetation of Arnold AFB. The 33 plant associations delineated for Arnold AFB are listed in Appendix B. Seventeen of the 33 vegetation associations found on Arnold AFB are considered “imperiled” community types.

### 3.3.3 Sensitive Species

Sensitive species include those with federal endangered or threatened status, species proposed for listing as federal threatened or endangered, and state endangered, threatened, and species of special concern status. An endangered species is one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is any species that is likely to become endangered in the future throughout all or a significant portion of its range due to loss of habitat, anthropogenic effects, or other causes.

AF projects that may affect federally protected species and species proposed for federal listing are subject to the ESA. The ESA requires designation of critical habitat for federally listed species. However, no areas on Arnold AFB are designated as critical habitat under the ESA. The species present on Arnold AFB that are protected under the ESA are described below. A list of all sensitive species on Arnold AFB is provided in Appendix C.

#### 3.3.3.1 *Myotis grisescens* (Gray Bat)

In size, the gray bat is the largest eastern representative of the genus *Myotis*. It occupies a limited geographic range in the limestone karst areas of the central and southeastern United States. The gray bat typically uses caves for both winter hibernation and summer roosting/maternity, although different caves are used for these two periods and bats may travel up to 325 miles between winter and summer habitat (Whitaker and Hamilton, 1998). Gray bats have narrow temperature requirements, which reduces the number of caves that are suitable for use. The species is particularly vulnerable, as 95 percent of the population

hibernates in only 9 caves, with over half the population hibernating in a single cave (Rommé and Reaves, 1999). The gray bat is federally listed as endangered due to declining numbers and loss of habitat. Flooding of summer maternity caves and hibernacula as a result of reservoir construction has been a major contributor to decline of the species (Rommé and Reaves, 1999).

Informal Section 7 consultations between representatives from Arnold AFB and USFWS occurred in 1978, 1979, and 1996. As a result, a management action plan was developed to coordinate continued Base operations and protection of the gray bat colony at Woods Reservoir Dam and foraging habitat across the Base. The gray bat colony that resides on Arnold AFB at Woods Reservoir Dam is listed as a priority 2 maternity colony in the USFWS Gray Bat Recovery Plan (1982) and is one of a very few maternity colonies that have been identified as using manmade structures for a maternity roost (Lamb, 2003b).

Gray bats forage primarily on aquatic insects along forested riparian corridors and use other forested corridors as travel routes. The canopy provides protective cover from potential predators (Rommé and Reaves, 1999; Lamb, 2003b). Mist net surveys at Arnold AFB have confirmed this life history characteristic, and gray bats have been captured while foraging along Elk River Bottoms, Bradley Creek, Brumalow Creek, and Rowland Creek. Gray bats also have been recorded with AnaBat II™ at Goose Pond, Sinking Pond, Tupelo Swamp, Westall Swamp, and near the Tennessee Valley Authority (TVA) substation.

Juvenile bats typically forage in wooded areas around the maternity cave (Rommé and Reaves, 1999; Lamb, 2003b). Therefore, protection of these areas also is important to recovery and maintenance of the species.

### 3.3.3.2 *Myotis sodalis* (Indiana Bat)

The Indiana bat is found in the eastern United States from eastern Oklahoma into Vermont and northwestern Florida. Indiana bats hibernate in caves and typically spend summers under the loose bark of trees in upland and bottomland forests and semi-wooded areas (Whitaker and Hamilton, 1998). Typically, Indiana bats make summer roost in hardwood trees with sloughing bark or cavities (Rommé and Reaves, 1999), but males have been documented roosting among the bark furrows of large pine trees on Wright-Patterson Air Force Base (R.A. King, USFWS, personal communication, 2004). As with gray bats, Indiana bats may migrate several hundred miles between winter and summer habitat (Rommé and Reaves, 1999).

Indiana bats forage on insects in a variety of habitats. This species typically forages in and around the tree canopy of riparian, floodplain, and upland forests. They also may forage along fencerows, crops, clearings, and farm ponds (Rommé and Reaves, 1999).

AnaBat II™ surveys in 2003 identified the possible presence of Indiana bats along Bradley and Brumalow Creeks, but the species has never been captured in mist nets on the Base. (Lamb, 2004b). There is some difficulty in positively identifying Indiana bats from calls recorded with an AnaBat II™ detector because of similarity and marginal overlap with other bat species. The USFWS does not currently accept AnaBat II™ identifications in the absence of confirmed captures (Robert Currie, USFWS, communication, 2004 to J.W. Lamb cited in Lamb, 2004b). Additional surveys would be required to confirm the presence of this species on the Base.

### 3.3.3.3 *Haliaeetus leucocephalus* (Bald Eagle)

The bald eagle is a federally threatened species. The bald eagle is found over most of North America, from Alaska and Canada to northern Mexico. There are an estimated 50,000 bald eagles in the United States, with 80 percent found in Alaska (Murphy et al., 1989).

The bald eagle is the only species of sea eagle that lives in North America. In the Southeast, bald eagles build their nests in early September. They usually build their nests in pine trees or bald cypress trees that are 1,000 feet or less from open water. In Everglades National Park, bald eagles nest in low mangrove trees or use nests that have fallen to the ground. But mostly, bald eagles build nests high in trees where they have a clear view of the water. These nests are large compared to the nests of other birds. The cone-shaped nests may be 6 feet across and from 6 to 8 feet from top to bottom. The nests are made of sticks and twigs from other trees. The nests may be lined with Spanish moss, corn husks, or grasses (Murphy et al., 1989).

Eagles may start laying eggs as early as late October. Most bald eagles in the Southeast lay eggs in the latter part of December. Bald eagles usually lay one or two eggs, sometimes three. The eggs take about 35 days to hatch. The newly hatched birds stay in the nest from 10 to 12 weeks. Bald eagle parents may care for their young for another 4 to 6 weeks after the eaglets learn to fly (Murphy et al., 1989).

Tennessee's bald eagle population is the highest in winter when birds migrate from the north. Most of the birds congregate during the winter at Reelfoot Lake and Dale Hollow Reservoir, but bald eagles may be observed on almost any waterway in the state (Tennessee Wildlife Resources Agency [TWRA], 2004).

Table 3-2 provides the numbers of mature and juvenile bald eagles observed at Woods Reservoir from 1988 through 2004. In most years a single pair of bald eagles winters on Woods Reservoir. Occasional sightings of transient eagles occur, but the species has not been documented nesting on Arnold AFB.

TABLE 3-2  
Number of Wintering Bald Eagles at Woods Reservoir (1988-2004)  
*Construction of SWMU 74 Groundwater Extraction and  
Conveyance System EA*

Year	Number of Adults	Number of Immature
1988	0	0
1989	2	0
1990	2	0
1991	2	0
1992	2	1
1993	2	0
1994	2	0
1995	1	0
1996	1	0
1997	2	0
1998	2	0
1999	1	0
2000	2	0

TABLE 3-2  
Number of Wintering Bald Eagles at Woods Reservoir (1988-2004)  
*Construction of SWMU 74 Groundwater Extraction and  
Conveyance System EA*

Year	Number of Adults	Number of Immature
2001	2	0
2002	2	0
2003	2	0
2004	1	1
Total	28	2

Data from J.W. Lamb, unpublished data.

### 3.3.3.4 *Helianthus eggertii* (Eggert's Sunflower)

Eggert's sunflower is the only federally listed threatened plant species known from Arnold AFB. Management actions for the species are integrated with other aspects of the Arnold AFB ecosystem management program by employing a coarse filter-fine filter approach. The coarse filter approach is to restore and maintain vegetation structure and ecological processes in suitable habitats for Eggert's sunflower. Such process-oriented management supports mission flexibility by working at multiple spatial and temporal scales to conserve biological diversity associated with one of the Base's focal conservation targets. The Barrens mosaic (Fitch, 2003). Fine filter protective measures specific to Eggert's sunflower are also taken to ensure that localized destruction of the species or its habitat does not encroach on mission flexibility by violating provisions of the ESA. Management is coupled with monitoring to help track impacts on the plant. AEDC Conservation implements management and develops projects to further the recovery objectives outlined by the USFWS (Fitch, 2003).

All aspects of Eggert's sunflower management on Arnold AFB are planned in coordination with the Cookeville, TN office of the USFWS. The Service's recommendations are incorporated when developing new management strategies and projects or addressing unforeseen operational impacts (Fitch, 2003).

The document entitled "AEDC Operational Information: Potential Impact to *Helianthus eggertii*" was developed and implemented through informal Section 7 consultation under the ESA. This document describes AEDC's operations, lists impacts on Eggert's sunflower that may occur from those operations, and outlines measures to reduce or avoid impacts when implementing Base operations. For each Base operation, the document gives the purpose of the operation, the method by which the operation is implemented, the potential impacts on the Eggert's sunflower resulting from each operation, and how to implement the operation to reduce/eliminate these impacts (Fitch, 2003).

It is understood that informal Section 7 consultation is to be reinitiated if (1) new information reveals impacts of the Proposed Action that may affect listed species or critical habitat in a manner not previously considered, (2) the Proposed Action is subsequently modified to include activities that were not considered during this informal consultation, or (3) new species are listed or critical habitat designated that might be affected by the Proposed Action (Call, 2003).

Prescribed burning, mechanical thinning, and invasive plant management are practices used to manage Eggert's sunflower on Arnold AFB. Eggert's sunflower habitat is maintained through Barrens restoration, forest management, and roads and ground operations, in addition to management of approximately 285 acres designed specifically for the species' conservation (Call, 2003). The management actions are driven by the recovery goals for the species, which are listed in the USFWS Recovery Plan for Eggert's sunflower (White and Ratzlaff, 2000). Through management, Arnold AFB seeks to minimize the threats to Eggert's sunflower, including vegetation succession, habitat destruction, and competition by invasive plants.

#### 3.3.3.5 *Pleurobema gibberum* (Cumberland Pigtoe)

Cumberland pigtoe is a federally threatened aquatic invertebrate bivalve species. A member of the mollusk family, it was previously found to exist at Arnold AFB. A single relict shell was found on Arnold AFB in a 1990 faunal survey (Mullen et al., 1995), but live specimens have never been found on the Base (Call, 2003). Additional relict shells have not been located in surveys conducted by USFWS since 1990 (J.W. Lamb, personal communication, 2004). This species is therefore not considered in this assessment.

#### 3.3.3.6 *Hemitremia flammea* (Flame Chub)

The flame chub is a species deemed in need of management in Tennessee and it is known to occur in Crumpton Creek (J.W. Lamb, personal communication, 2004). The flame chub is the only species in its genus and is restricted to the southeastern United States, primarily in eastern and central Tennessee (Etnier and Starnes, 1993). This fish typically inhabits springs and spring runs with lush aquatic vegetation (Etnier and Starnes, 1993).

### 3.3.4 Sensitive Habitats

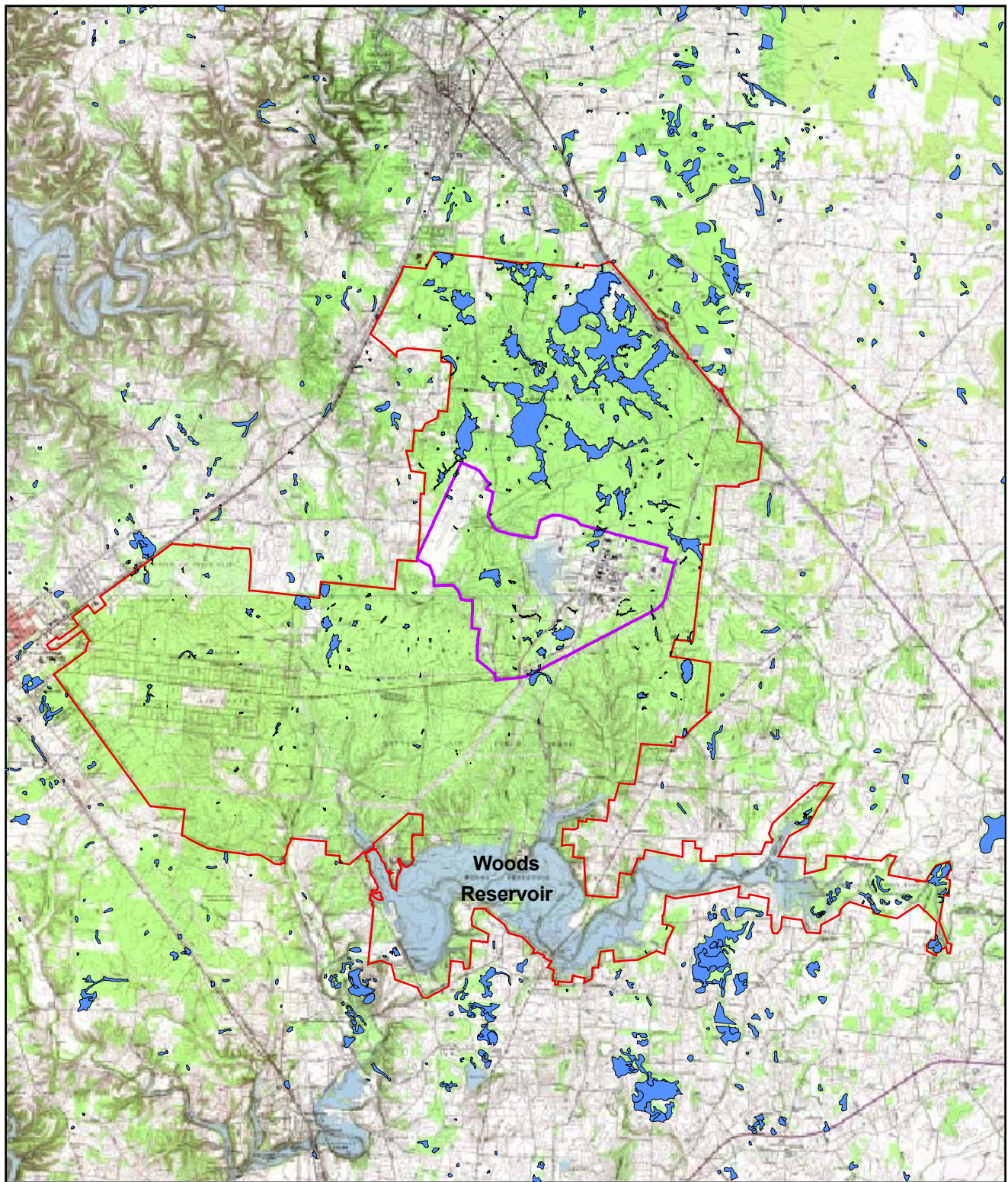
Sensitive habitats are described as those habitats supporting threatened or endangered plant and animal species, areas determined to be exemplary natural communities by federal or state agencies, or habitat areas exceptionally fragile and susceptible to damage. The sensitive habitats meeting these criteria occurring on the Base are the wetlands habitat, woodland/savanna/grassland habitat, and upland dry-mesic forests habitat.

#### 3.3.4.1 Wetland Habitat

Wetlands are inundated (water-covered) areas, or areas where water is present either at or near the surface of the soil for distinguishable periods of time throughout the year. Local hydrology and prolonged soil saturation largely affect soil formation and development, as well as the plant and animal community composition in wetland areas.

Wetland flats and depressions are the two primary wetland types on Arnold AFB. The USFWS completed a wetlands inventory and mapping project on Arnold AFB in 1998 and documented 1,894 acres of wetlands in 220 sites (Figure 3-3). Two hundred wetlands on Arnold AFB totaling about 1,775 acres are classified as either flats or depressions. At present, an interagency effort is underway to develop models, on the basis of hydrology and geomorphology, for assessing function in wetland flats and depressions. This and other ongoing projects would increase the understanding of how varying land uses in and adjacent to wetlands influence wetland function.





0 1.25 2.5  
Miles



#### LEGEND

- ▬ AEDC Boundary
- ▬ Arnold AFB Boundary
- ▬ Wetlands



Figure 3-3

#### Wetlands Located on Arnold Air Force Base

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Wetlands at Arnold AFB result from three major geomorphic features: karst pans, compound sinks, and intermittent headwater streams (Call, 2003). Karst pans typically have depths less than 4.9 ft and level bottom topography. Compound sinks generally have depths greater than 8.2 ft and complex bottom topography dominated by internal drainage systems consisting of coalesced sinkholes and connecting channels.

Wetlands associated with headwater streams display a rapid surface water response to localized precipitation events. These areas remain wet for extended periods due to level topography and poorly drained soils. Hydrologic monitoring at Arnold AFB has identified distinct water regimes associated with karst pans and compound sinks.

Two karst pans, Tupelo Swamp and Goose Pond, have water regimes characterized by narrow ranges of flooding depth, gradual seasonal rises and recessions, long hydroperiods, persistent soil saturation, and perched surface water systems. These similarities persist across significantly different hydrologic conditions. Most pans on the Base support wet forests of willow oak, sweet gum, black tupelo, or red maple, but several support unusual natural communities that often include rare or disjunct plants and animals (Call, 2003).

Three compound sinks, Sinking Pond, Westall Swamp, and Willow Oak Swamp, share the geomorphic characteristics of about 9.8 ft of internal relief and plainly visible sinkhole drains. Their water regimes are characterized by abrupt seasonal rises and recessions, typically 6.6 ft or more during periods as short as 1 to 3 days, and close interactions between surface water and groundwater. These interactions include water table control of sinkhole drainage and very flashy groundwater response under the influence of concentrated recharge through the sinkholes. The annual flooding behavior of compound sinks is more sensitive to rainfall during the fall and early winter than to total annual rainfall (Call, 2003). Sinking Pond, designated a National Natural Landmark by the U.S. National Park Service, is well known locally for its abrupt seasonal flooding and draining. One of the most pristine areas at Arnold AFB, Sinking Pond, also is the site of one of the largest great blue heron rookeries in Tennessee. The number of active great blue heron nests identified at Sinking Pond since 1965 is provided in Figure 3-4. Surveys were not conducted from 1989 through 1997.

According to the IEMP, 10 plant association communities identified as target conservation communities by the Integrated Process Team (IPT) are included in the wetland flats and depressions classification. The communities are listed in Appendix C.

Twenty-six species identified as target conservation species by the IPT are associated with wetland flats and depressions. The gopher frog (*Rana capito*) occurs in wetlands on Arnold AFB. However, the subspecific status of the gopher frog on Arnold AFB has not yet been determined. The Arnold AFB population of gopher frog is disjunct, separated from the nearest other population by several hundred miles and may represent a distinct, as yet undescribed, subspecies. The three subspecies of the gopher frog recognized in the scientific literature are considered species of concern by the USFWS. Many of the rare plants associated with the wetland flats and depressions classification also are disjunct populations of species whose central ranges are limited to the Atlantic or Gulf Coastal Plains. Several of the disjunct species associated with wetland flats and depressions are documented in Tennessee only from Arnold AFB. A list of all the conservation target species associated with wetlands on Arnold AFB and the wetland types in which they are typically found is provided in Appendix D.

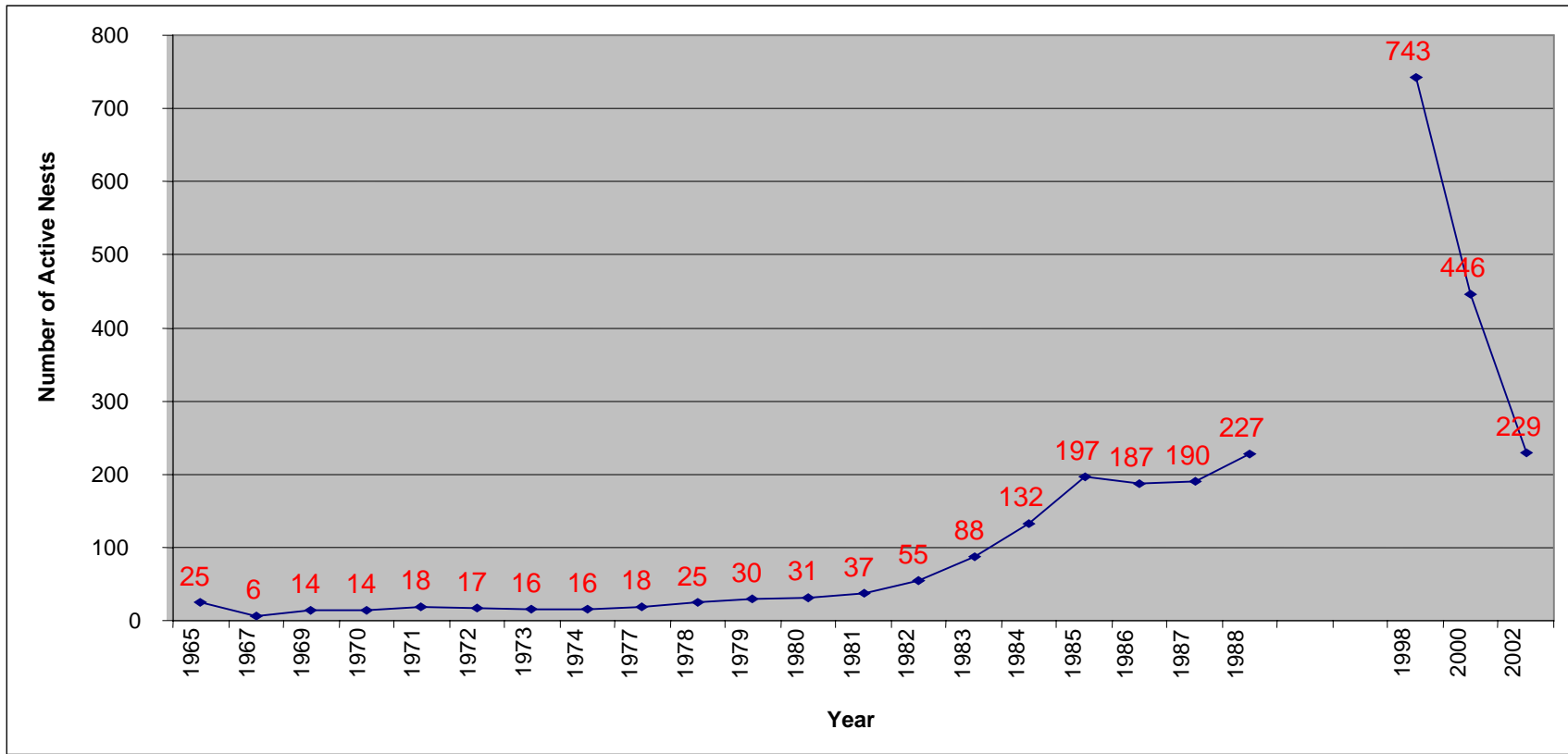


FIGURE 3-4

Number of Great Blue Heron Nests Identified at Sinking Pond from 1965 through 2002

*Construction of SWMU 74 Groundwater Extraction and Conveyance System*

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Data for 1965 through 1988 from Pullin (1980 and 1990). Data for 1998 from Carter et al. (1998). Data for 2000 and 2002 from J.W. Lamb (unpublished data).

#### 3.3.4.2 Woodland/Savanna/Grassland Habitat

This classification represents a significant component of the Barrens mosaic, which historically characterized much of Arnold AFB and the landscape within which it is situated. The woodland and savanna components include lightly forested, oak-dominated habitats with a grass- and forb-dominated understory. Savannas are grasslands with a minor canopy cover; woodlands are low-density forests with a well developed herbaceous understory. Fire exclusion since approximately the 1940s has led to the succession of most woodland and savanna habitats into forested habitats with shrub-dominated understories (e.g., some communities included in the upland dry-mesic forest described below). However, aerial photography from the late 1930s indicates that a woodland/savanna mosaic was a dominant habitat in the premilitary landscape on Arnold AFB.

Grasslands are the habitat most commonly described in the scientific literature regarding The Barrens of Tennessee. They probably occurred historically as scattered openings in the woodland/savanna mosaic, but also have undergone vegetative succession in the absence of wildfire across much of the landscape. The grasslands at Arnold AFB are dominated by grasses characteristic of tallgrass prairies in the midwestern United States, and also include many wildflower and bird species associated with that region.

According to the IEMP (Call, 2003), seven vegetation communities identified as conservation targets by the IPT are included in the woodland/savanna/grassland classification (Appendix C). Their distributions are linked to ecological gradients that are influenced by soil series, moisture, disturbance, and topographic position, among other factors.

There are 18 species and one species guild identified as conservation targets by the IPT in woodland/ savanna/grassland habitats. The species are divided into two groups: one associated with dry sites and the other with mesic sites (Appendix D). Some of the species may occur across the soil moisture gradient, but they are associated here with the habitat in which they are commonly found. Eggert's sunflower is the only federally listed (threatened) species associated with woodland/ savanna/grassland. The guild identified for the classification is songbirds that utilize early successional habitats cited by Partners in Flight in the Interior Low Plateaus draft Bird Conservation Plan (Ford et al., 1998). Species of concern include:

- Henslow's Sparrow (*Ammodramus henslowii*)
- Bachman's Sparrow (*Aimophila aestivalis*)
- Grasshopper Sparrow (*Ammodramus savannarum*)
- Blue-Winged Warbler (*Vermivora pinus*)
- Prairie Warbler (*Dendroica discolor*)
- Northern Bobwhite (*Colinus virginianus*)
- White-Eyed Vireo (*Vireo griseus*)

#### 3.3.4.3 Upland Dry-Mesic Forests Habitat

The most prevalent habitat type on Arnold AFB lands is the upland forest that occupies most of the broad ridges and slopes on the Base. Portions of this forest may present opportunities for restoring woodland or savanna communities, such as were present

historically. However, the upland dry-mesic forests are also regionally important in their current condition, as large, contiguous forested tracts are uncommon in the southeastern portion of the Highland Rim physiographic province. The larger, mature forest tracts on Arnold AFB provide important breeding territory for interior forest songbirds and also help in many ways to maintain the function of nearby wetland habitats.

Five conservation target communities are included in the upland dry-mesic forests classification (Appendix C).

The upland dry-mesic forests collectively have focal conservation targets on Arnold AFB. Five community types are included in the upland dry-mesic forest classification:

- *Quercus falcata* - *Quercus coccinea* - *Quercus (stellata, velutina)/Vaccinium pallidum* Forest (Southern red oak - scarlet oak - post (black) oak/lowbush blueberry Forest)
- *Quercus falcata* - *Quercus alba* - (*Quercus coccinea*)/*Oxydendrum arboreum/Vaccinium pallidum* Forest (Southern red oak - white (scarlet) oak/sourwood/lowbush blueberry Forest)
- *Quercus alba* - *Quercus (falcata, stellata)/Chasmanthium laxum* Forest (White oak - southern red (post) oak/slender woodoats Forest)
- *Juniperus virginiana* var. *virginiana* - *Quercus* spp. Forest (Eastern red cedar - oak Forest)
- *Juniperus virginiana* var. *virginiana/Rhus copallinum/Schizachyrium scoparium* Forest (Eastern red cedar/winged sumac/little Bluestem Forest)

The single conservation target species guild identified is interior forest songbirds that require large (i.e., >500 acres), contiguous forest tracts for establishing breeding territories and includes:

- Wood Thrush (*Hylocichla mustelina*)
- Scarlet Tanager (*Piranga olivacea*)
- Ovenbird (*Seiurus aurocapillus*)

The original forest vegetation on Arnold AFB consisted of an oak-hickory forest type on the better-drained soils and a mixed bottomland hardwood type on the poorly drained soils. High grade logging practices and burning for woodland pasture for over 100 years have developed an understocked forest which consists primarily of blackjack oak, post oak, and scarlet oak on the poorer upland soils. The better stands of southern red oak, white oak, water oak, and willow oak occur on the wetter sites.

Pine is not native to this part of Tennessee but grows well on most sites in this area. Approximately 4,300 acres of pine were planted between 1950 and 1960. This was done as part of a sound attenuation program designed to establish a noise barrier between Arnold AFB and the surrounding communities. Old fields and other areas that required little or no site preparation were planted with loblolly, shortleaf, white, and Virginia pines. An additional 1,400 acres were planted between 1960 and 1972. These plantings converted poor quality hardwood with low productivity into more productive loblolly pine. A pine reforestation program was initiated in 1983 that re-establishes loblolly pine on pine sites where final harvests have been accomplished. During the early years of this reforestation effort, a few abandoned agricultural fields (less than 200 acres) were also converted to loblolly pine. Loblolly pine is used exclusively for the reforestation program because it has proven to grow better over a wide range of site classes.

### 3.4 Cultural Resources

Section 106 of the NHPA requires that federal agencies analyze the impacts of federal activities on historic properties. Areas potentially impacted by mission activities are surveyed as part of the AF Cultural Resources Management Program.

Surveys conducted on Arnold AFB have identified 107 prehistoric and historic sites dating back to Early Archaic times (Hajic et al., 2002). These include 40 prehistoric sites, 55 historic sites, and 12 mixed prehistoric and historic sites. Of these 107 sites, 6 have been deemed eligible for listing on the National Register of Historic Places (NRHP) and 40 are considered potentially eligible (R. Alvey, personal communication, 2004). The prehistoric sites include open habitations, isolated projectile points/knives, and a midden mound. The historic sites include the remains of houses, outbuildings, wells, cemeteries, and trash dumps (Call, 2003). Due to the sensitive nature of these sites, their exact locations are undisclosed.

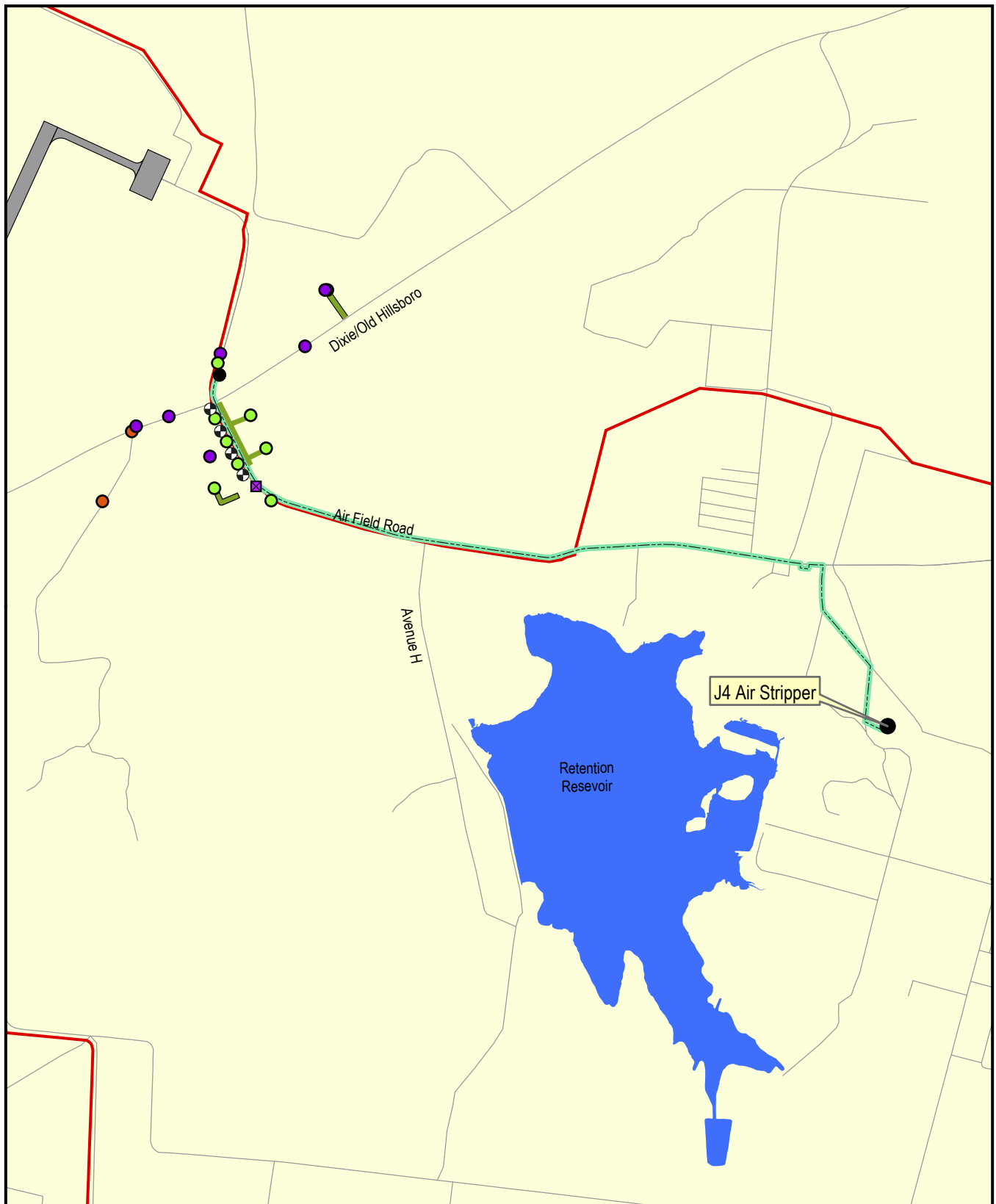
A total of 340 buildings on Arnold AFB were surveyed by Geo-Marine Inc, and 104 of these structures are considered eligible for listing in the NRHP (Peyton, 2004a; 2004b; R. Alvey, personal communication, 2004). In accordance with NRHP eligibility criteria, most notably Criteria Consideration G, 31 facilities at Arnold AFB have exceptional significance and are therefore recommended as eligible for the NRHP under Criteria A and C. The facilities illustrate the Cold War heritage of the United States in the area of materiel development, and they illustrate key Cold War themes, especially in the area of science and technology. The facilities retain integrity and display distinguishing engineering, technological, and scientific characteristics (Peyton, 2004a; 2004b; TRC Garrow Associates et al., 2001).

Pre-dating Arnold AFB, Camp Peay occupied a 1,040-acre tract in the southwest portion of the present Base. It was established in 1926 as a Tennessee National Guard camp. Subsequently, Camp Forrest was founded in 1941, also predating Arnold AFB. Located mostly within present Base boundaries and encompassing 85,000 acres, it was one of the nation's largest training centers just before World War II. Approximately 22,000 prisoners of war were housed here, representing a number of nationalities, including resident aliens, Germans, and Italians (TRC Garrow Associates et al., 2001). After the war ended, Camp Forrest was declared a surplus property and the buildings and support systems were dismantled and sold (TRC Garrow Associates et al., 2001). There are four surviving structures associated with Camp Forrest: two small concrete utility buildings of unknown use, a former brick jail, and a cold storage building. These resources were recommended as ineligible for the NRHP due to loss of integrity and loss of context caused by the removal of Camp Forrest (TRC Garrow Associates et al., 2001).

### 3.5 Traffic Flow and Utility Infrastructure

Within the AEDC industrial complex, existing roads are sufficient to accommodate traffic flow of the workforce and delivery of materials and supplies. The Main Gate and Gate No. 2 are open to allow ingress and egress of traffic. Streets are arranged to provide easy access to all buildings and parking areas.

The project area is along Air Field Road, the two-lane paved road leading from the main AEDC industrial complex to the air field (Figure 3-5). Dixie/Old Hillsboro Road crosses Air



0 1,000 2,000 Feet



#### Legend

- |   |                             |                       |
|---|-----------------------------|-----------------------|
| ● Existing Extraction Well              | ⊗ Proposed Extraction Wells | □ Arnold AFB Boundary |
| ● Proposed Deep Monitoring Well         | □ AEDC Boundary             | — Road                |
| ● Proposed Intermediate Monitoring Well | ■ Airfield                  | — Proposed New Road   |
| ● Proposed Piezometer                   | ■ Reservoirs                | — Water Transfer Pipe |
| ⊗ Proposed Transfer Lift Station        |                             |                       |



Figure 3-5

#### Roads in the Project Area

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Field Road in the project area, but Dixie/Old Hillsboro Road is barricaded and gated on the northeast side of the intersection with Air Field Road. Additional tertiary roads occur in the project area, but these are not “through roads” and receive little traffic.

Utility infrastructure in the project area includes the electric transmission line ROW a sewer sump at the J6 Test Cell, and various buried utility lines at the J6 Test Cell. Buried utility lines at the J6 Test Cell provide electrical service to the test cell and to light poles surrounding the test cell. Buried water and gas lines also provide service to the building.

## 4.0 Environmental Consequences

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### 4.1 Geomorphology

Disturbance to soils would occur from laying gravel for road bed formation, trenching and drilling during installation of the pumps, water line, piezometers, and groundwater wells.

#### 4.1.1 Proposed Action

Under the Proposed Action, three road beds would require placement of gravel to support vehicle traffic and to minimize the creation of ruts in the soil. No grading would be required. These roads would follow the existing ground contours. Impacts are expected to be minor. Under the Proposed Action, 4 extraction wells, 12 monitoring wells (4 deep wells and 8 intermediate wells), and 10 piezometers would be installed. These installations would result in localized soil disturbance from drilling. Concrete would be poured around the tops of the wells and piezometers for placement of protective casing, caps, and locking lids, and the concrete would be level with the existing ground surface. The area of disturbance and concrete would be less than 9 square feet per well. This is equivalent to an estimated 234 square feet of impervious surface created for implementation of the SWMU 74 groundwater extraction and conveyance system.

Drilling wastes would include material in contact with the Plume, which would be treated as contaminated and disposed of according to Arnold AFB policy for disposal of hazardous wastes.

#### 4.1.2 No-Action Alternative

No soil disturbance or impacts on geomorphology would result from the No-Action Alternative.

### 4.2 Hydrology and Water Quality

Impacts on hydrology could result from inter-basin transfer, pumping water from one basin and discharging it in another basin. Additional hydrologic impacts could result from land clearing, loss of vegetation, and associated accelerated runoff following precipitation events. Impacts on water quality could result from construction activities that result in soil disturbance and exposed soil, presenting the possibility for the transport of sediment into streams. Transport could occur downslope or into immediately adjacent waters.

#### 4.2.1 Proposed Action

The Plume emerges from the ground at Rutledge Falls, which is in the Crumpton Creek watershed. The SWMU 74 groundwater extraction and conveyance system would extract, on an annual basis, 52.6 million gallons. It is assumed that this water was destined for Crumpton Creek, as discussed in Section 2.1. According to data from the U.S. Geological



Survey (USGS) gauging station on Crumpton Creek, the stream flow at Rutledge Falls is 26 cubic feet per second (11,670 gpm). The total amount of water extracted from the groundwater upgradient of Rutledge Falls would be equivalent to 0.9 percent of the annual mean stream flow and would be considered a minor impact.

The J4 GWTU discharge flows into the Retention Reservoir, which empties into Woods Reservoir via Rowland Creek. This results in moving water from the Crumpton Creek watershed to the Rowland Creek watershed. However, the Proposed Action would not need an inter-basin transfer permit because both Crumpton Creek and Rowland Creek are within the Tennessee Western Valley River Basin (TDEC, 2004d).

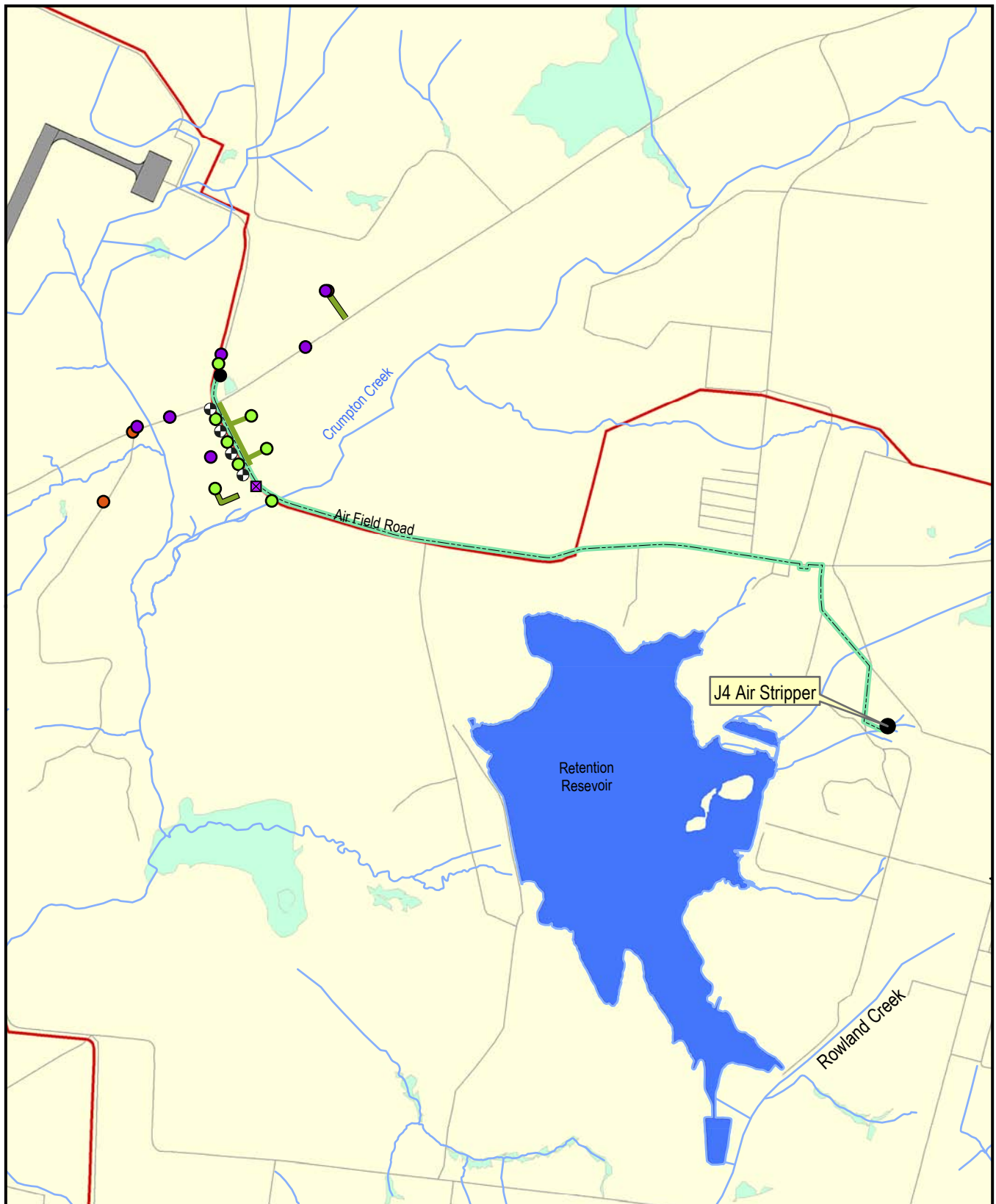
The construction impacts on hydrology would be minimal because of the small area of disturbance and use of appropriate erosion and stormwater controls, including silt fencing and immediate site stabilization. There would be no change in land use, erodability, or stormwater conveyance within streamside management zones. Any impacts on hydrology resulting from construction would be temporary and minor.

Potential impacts on water quality would be limited to those resulting from transport of sediments and organic matter. No streams are in proximity to the proposed extraction wells (Figure 4-1). However, all extraction well locations are along a roadside ditch where soils disturbed during construction could be transported to Crumpton Creek. The water line would be installed adjacent to a roadside ditch that could transport sediment to surface waters. Three monitoring wells would be located near a tributary of Crumpton Creek and one piezometer would be installed adjacent to Crumpton Creek (Figure 4-1). All of these activities have the potential to impact surface waters from runoff following soil disturbance.

Two streams would be crossed by the water line, but without impact. Each stream crossing is adjacent to a roadway that has a culverted crossing of the stream. There is sufficient soil above the culvert to place the water line between the culvert and the surface, without a need to disturb the creek. The trenched area would be returned to pre-construction contours and revegetated immediately after the water line is installed. Silt fences would be placed between trenching and drilling areas and streams and between these areas and ditches that could convey runoff into surface waters. Disturbed surface areas would be stabilized immediately after water line or well/piezometer installation.

The groundwater extraction and conveyance system would discharge into the Retention Reservoir (Figure 4-1) under TN0003751. The discharge would comply with the MCL for TCE and would not impact water quality in the Retention Reservoir and Rowland Creek.

Discharge of fuels and lubricants into waters of the State of Tennessee as part of equipment maintenance and refueling is a violation of the Tennessee Water Quality Control Act (TWQCA). Vehicle operation, refueling, and maintenance during project implementation would involve fuels and petrochemicals that could impact water quality if released into the environment. However, the contractor would be required to follow proper procedures and Best Management Practices (BMPs) for operation, maintenance, and refueling of vehicles to minimize and avoid impacts on water quality from accidental spills. These procedures include keeping all vehicles and other equipment in proper operating condition, not conducting refueling and maintenance activities within 100 feet of an intermittent or



0 1,000 2,000 Feet



#### Legend

- |   |                             |                       |
|---|-----------------------------|-----------------------|
| ● Existing Extraction Well              | ⊗ Proposed Extraction Wells | ▭ Arnold AFB Boundary |
| ● Proposed Deep Monitoring Well         | ▭ AEDC Boundary             | ▭ Road                |
| ● Proposed Intermediate Monitoring Well | ▭ Airfield                  | ▭ Proposed New Road   |
| ● Proposed Piezometer                   | ▭ Reservoirs                | ▭ Water Transfer Pipe |
| ⊗ Proposed Transfer Lift Station        | ▭ Wetlands                  | ▭ Streams             |



Figure 4-1  
Wetlands and Streams near  
the Proposed Project Area

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perennial stream or a wetland, and storing all fuels and lubricants in proper containers and cabinets more than 100 feet from any stream or wetland.

BMPs for maintaining soil and water quality would be adhered to throughout construction activities. These actions would avoid or minimize impacts on water quality. Therefore, no more than minor, temporary adverse impacts on water quality associated with well and water line installation are expected to result from the Proposed Action. There would be a long-term benefit to water quality from decreasing the TCE levels in groundwater within the Plume.

#### 4.2.2 No-Action Alternative

There would be no inter-basin transfer of water and no change to existing runoff conditions resulting from implementation of the No-Action Alternative. No soil disturbing activity or vehicle maintenance or refueling would be associated with the No-Action Alternative. Therefore, the No-Action Alternative would have no negative impacts on hydrology or water quality. However, the No-Action Alternative would not provide long-term water quality benefits from decreasing elevated TCE levels in the Plume.

### 4.3 Installation Restoration Program

#### 4.3.1 Proposed Action

The Proposed Action is a component of the effort to address contamination at SWMU 74. Implementation of the Proposed Action would reduce levels of TCE in the plume and in wells down-gradient from the Base (Figure 4-2). The Proposed Action would:

- Reduce concentrations of chlorinated solvents at the Base boundary.
- Restore the off-Base aquifer to unrestricted use.
- Facilitate future expansions of the groundwater extraction and conveyance system in other areas, if needed, to achieve the long-term goals for SWMU 74 (e.g., MW-305 area north of the Retention Reservoir, Fire Training Area).
- Establish an operational strategy to provide centralized groundwater treatment for the MTA and surrounding areas within Arnold AFB.
- Provide an interim measure that should be acceptable to the applicable regulatory agency (i.e., TDEC), as well as the surrounding community.
- Be easily integrated into additional interim measures that may be implemented in the future (as part of the overall SWMU 74 CMS) to achieve the long-term cleanup goals for the Plume.

The Proposed Action would address the short-term IRP cleanup goal to reduce concentrations of chlorinated solvents to below MCLs in the portion of the Plume that extends beyond the Base boundary. The long-term IRP cleanup goal is to reduce chlorinated solvent concentrations in the entire Plume to below MCLs. This goal is supported by the Proposed Action for the portion of the Plume down-gradient of the proposed groundwater

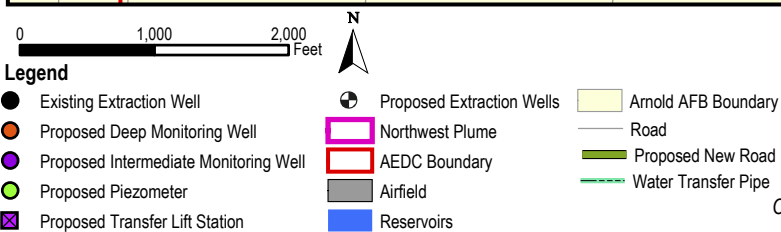
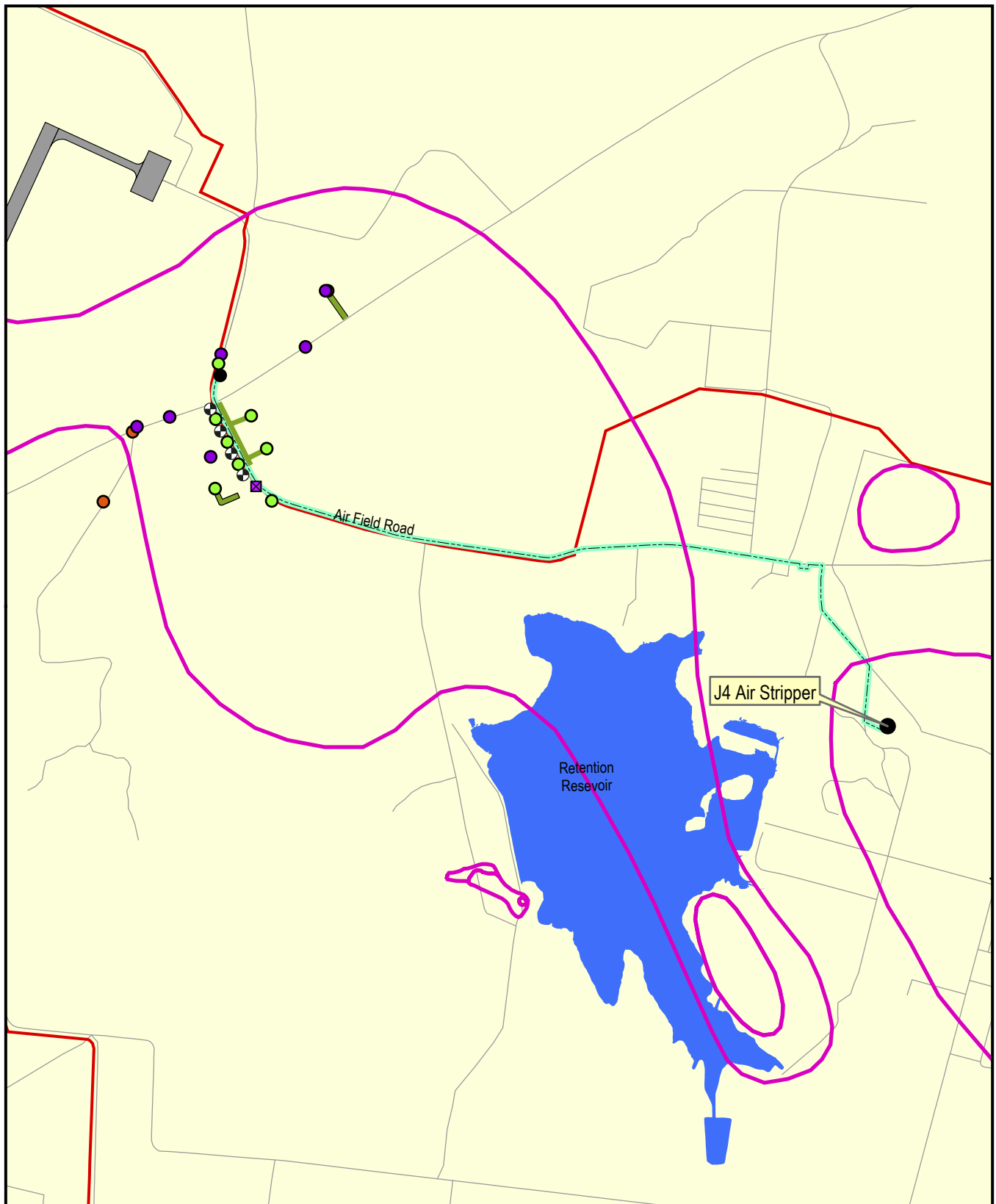


Figure 4-2

### Proposed Action and Northwest Plume

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extraction and conveyance system. However, this interim measure does not address the long-term goal for the portion of the Plume upgradient of the proposed groundwater extraction and conveyance system. Additional measures may be implemented in the future to achieve the long-term goal for the upgradient portion of the Plume and the Proposed Action would be compatible with the possible future actions. Therefore, the Proposed Action is consistent with and would benefit the IRP.

#### **4.3.2 No-Action Alternative**

The No-Action Alternative would not be consistent with or benefit the IRP at Arnold AFB. Implementation of the No-Action Alternative would result in a continuation of current conditions, including TCE concentrations in the Plume that exceed the MCL beyond the Base boundary.

### **4.4 Biological Resources**

Impacts would occur if activities were to physically damage or kill an individual of a species, disturb or displace a species without causing physical harm, or alter habitat such that species vigor or reproduction were decreased. This section examines potential impacts and discusses project design features that would be implemented to avoid or minimize impacts.

#### **4.4.1 Non-Sensitive Species**

##### **4.4.1.1 Proposed Action**

Installation of the water line and monitoring wells would result in the loss of dominant vegetation in the areas that would be excavated or drilled. This would be a direct localized loss of plant species and potential displacement of animal species from the construction areas. Most of the area that would be disturbed is within maintained ROW, which has minimal animal use. This design would minimize potential impacts on native vegetation and animals. Vegetation would quickly recover after construction and displacement of animals would be temporary. Limited incidental mortality to animals may occur should the trencher encounter a burrowing mammal or reptile. Any such incidental loss would not significantly impact animal populations on the Base. The total acreage to be disturbed is small, as the trench would be only 6 inches wide. Any impacts on animal populations are expected to be temporary and minor.

##### **4.4.1.2 No-Action Alternative**

Under the No-Action Alternative, no wells, pumps, or piping would be installed and no ground disturbance would result. Therefore, no impacts on non-sensitive species would result from implementation of the No-Action Alternative.

## 4.4.2 Sensitive Species

### 4.4.2.1 Proposed Action

#### Gray Bat

The Proposed Action would not cause direct physical injury to gray bats, as no bats would be present when construction is occurring. Gray bats do not roost in trees, and they forage at night when construction activities have ceased. No streamside management zones (SMZs) would be cleared under the Proposed Action. Gray bats typically travel and forage along riparian corridors, so there would be no impacts on their preferred travel/foraging habitat and no indirect impacts on gray bats resulting from impacts on riparian habitat. Gray bats also have been documented foraging and traveling on Arnold AFB in and across habitats (clearings and forest) that are not riparian (Lamb, 2004b). There would be no change in cleared habitat in the vicinity of the Proposed Action that could indirectly impact gray bats through changes in their prey base. Gray bats have not been recorded in the project vicinity, with the nearest recorded occurrence more than 2 miles to the south (Figure 4-3). Therefore, no indirect impacts on gray bats are expected to result from the Proposed Action.

#### Indiana Bat

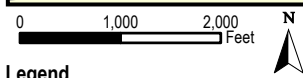
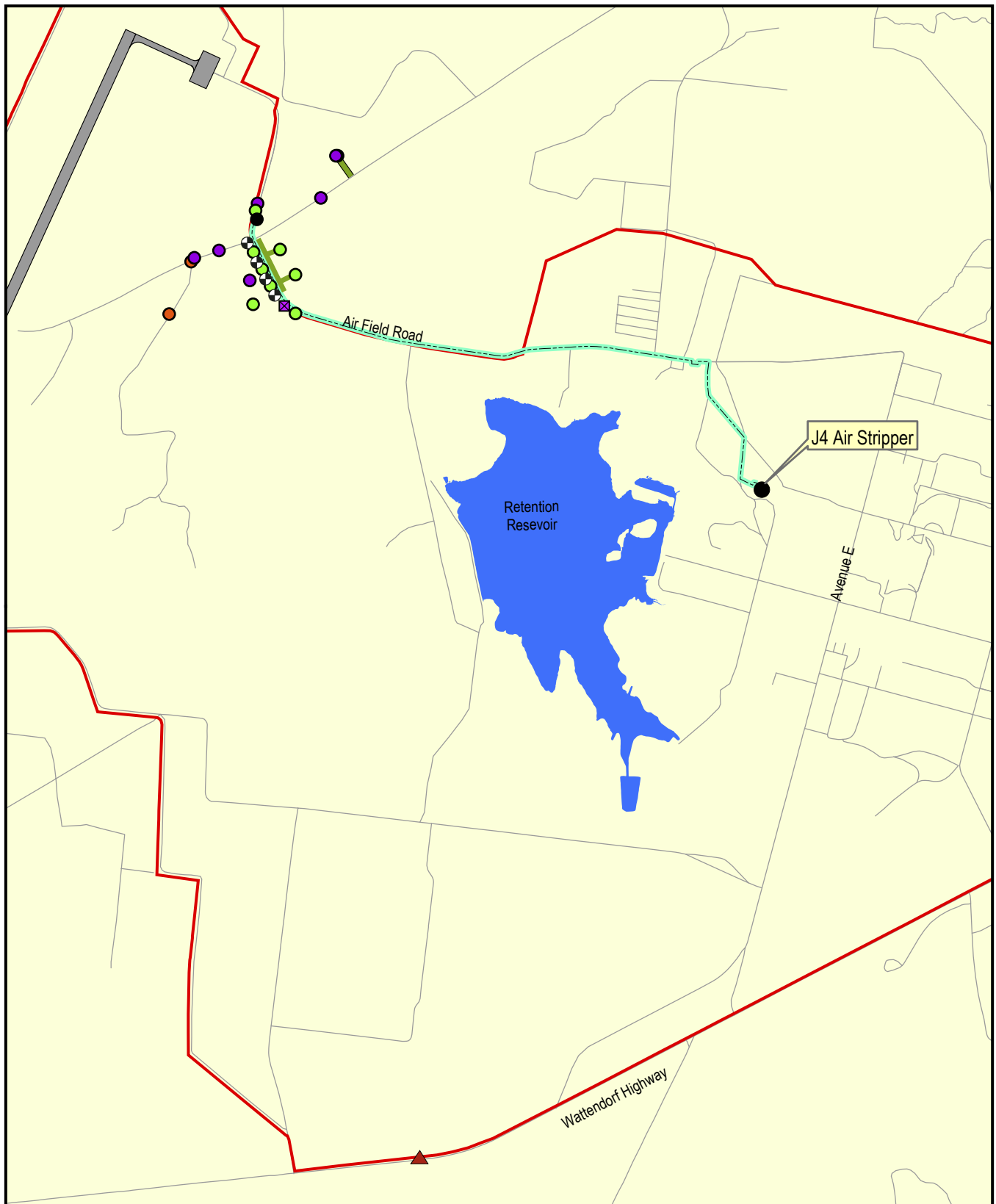
In 2003, AnaBat II™ surveys detected the possible presence of Indiana bats on Arnold AFB (Lamb, 2004b). However, the species has never been captured in mist net surveys on the Base. While the status of occurrence of the Indiana bat on Arnold AFB is uncertain, the Proposed Action would not impact the species. All work would be confined to existing cleared areas and all work would occur during normal business hours. No trees would be removed to implement the Proposed Action, so no loss of potential roosting or foraging habitat would result.

#### Bald Eagle

The bald eagle has been documented using the area around Woods Reservoir but not within the industrial complex or near the air field. Given the level of human activity in the proposed project area, it is unlikely that bald eagles would begin using these areas in preference to Woods Reservoir and adjacent areas. Because the Proposed Action would not negatively impact water quality in the Retention Reservoir, there would be no impacts on the species or its prey base should transient bald eagle use of the Retention Reservoir occur. Therefore, no impacts on bald eagle on Arnold AFB are expected to result from the Proposed Action.

#### Eggert's Sunflower

Eggert's sunflower is widely distributed on Arnold AFB. There are multiple areas where Eggert's sunflower is known to occur in the project vicinity (Figure 4-4). Four wells to be located along tertiary roads west of Air Field Road are within Eggert's sunflower habitat. These well locations were coordinated with ATA Natural Resource staff to avoid impacts on the species. The piezometers that would be located east of Air Field Road and the access road to reach the piezometer locations would be adjacent to Eggert's sunflower habitat. These locations also were coordinated with ATA Natural Resource staff to avoid impacts on the species. No impacts on Eggert's sunflower would result from the Proposed Action.



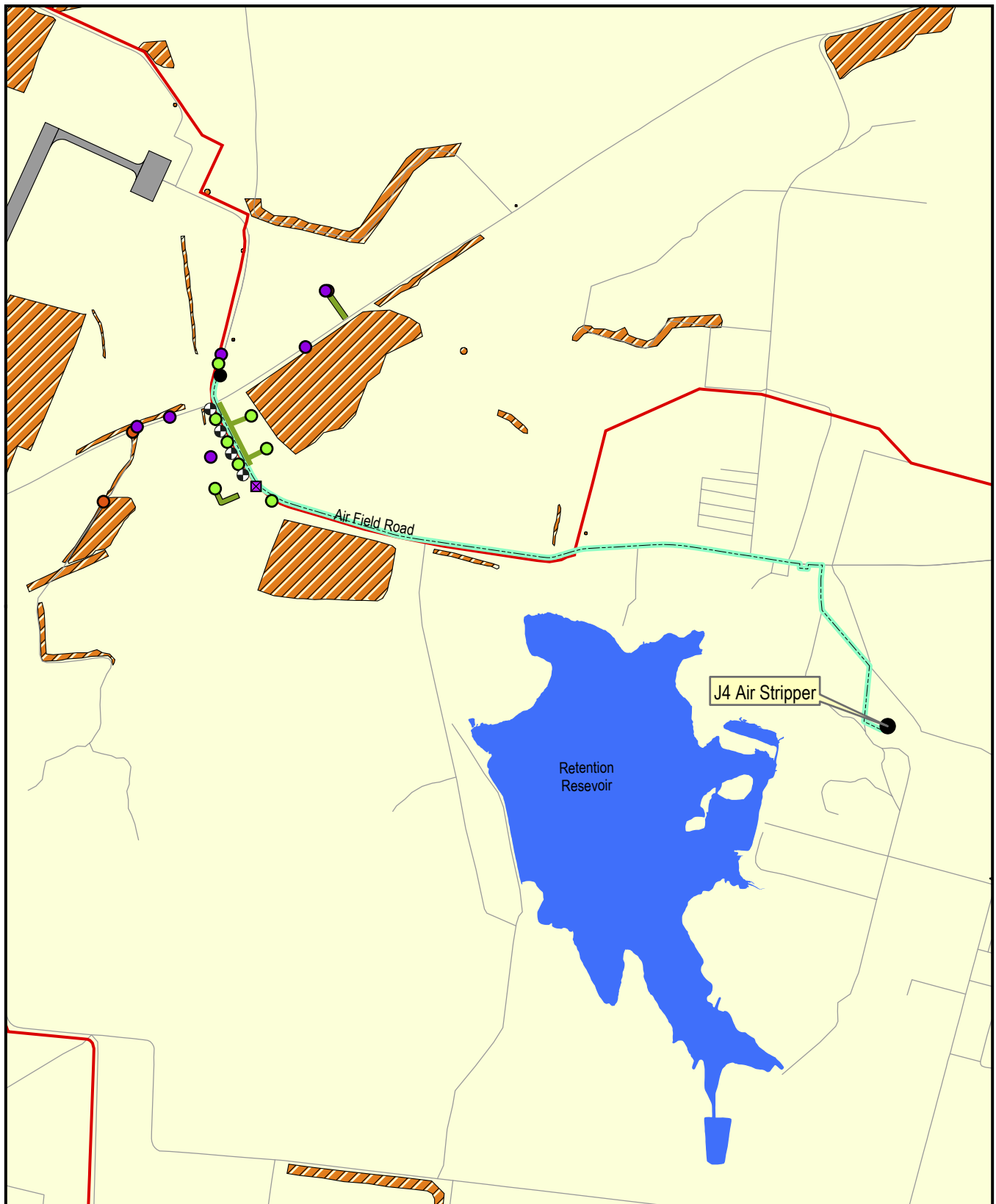
#### Legend

- |   |                             |                       |
|---|-----------------------------|-----------------------|
| ● Existing Extraction Well              | ⊙ Proposed Extraction Wells | □ Arnold AFB Boundary |
| ● Proposed Deep Monitoring Well         | ▲ Gray Bat Occurrence       | — Road                |
| ● Proposed Intermediate Monitoring Well | □ AEDC Boundary             | — Proposed New Road   |
| ● Proposed Piezometer                   | ■ Airfield                  | — Water Transfer Pipe |
| ⊠ Proposed Transfer Lift Station        | ■ Reservoirs                |                       |



Figure 4-3  
**Recorded Occurrences of Gray Bats  
 near the Proposed Project Area**

Construction of SWMU 74 Groundwater Extraction and Conveyance System  
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#### Legend

- |   |                                  |                       |
|---|----------------------------------|-----------------------|
| ● Existing Extraction Well              | ⊕ Proposed Extraction Wells      | □ Arnold AFB Boundary |
| ● Proposed Deep Monitoring Well         | ▨ Eggert's Sunflower Occurrences | — Road                |
| ● Proposed Intermediate Monitoring Well | □ AEDC Boundary                  | — Proposed New Road   |
| ● Proposed Piezometer                   | ■ Airfield                       | — Water Transfer Pipe |
| ⊗ Proposed Transfer Lift Station        | ■ Reservoirs                     |                       |



Figure 4-4  
**Recorded Occurrences of Eggert's  
 Sunflower and the Proposed Project Area**

Construction of SWMU 74 Groundwater Extraction and Conveyance System  
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## **Flame Chub**

The flame chub is known to occur in Crumpton Creek. The water line crosses Crumpton Creek, but there would be no impacts on the creek as the crossing would be made through soil above the road culvert and no construction would occur in the creek. Therefore, construction would not impact the flame chub. The water from the J4 Test Cell GWU would continue to discharge into the Retention Reservoir, which discharges into Rowland Creek. Since the flame chub does not occur in Rowland Creek, no impact would result from the Proposed Action.

### **4.4.2.2 No-Action Alternative**

Under the No-Action Alternative there would be no drilling or trenching and no associated clearing and soil disturbance. Therefore, no impacts on sensitive species would result from implementation of the No-Action Alternative.

## **4.4.3 Non-Sensitive Habitats**

### **4.4.3.1 Proposed Action**

The Proposed Action would be placed primarily within existing maintained road and electrical transmission ROWs. These areas provide little habitat value, as they are regularly mowed. One monitoring well and two piezometers would be placed within management units designated for pine pulp/sawtimber production. These structures and a gravel road leading to the piezometers would be placed within pine management units to the north and south of Dixie/Old Hillsboro Road. The pines south of the road are early regeneration, averaging approximately 5 feet in height. The pines north of the road are more mature and average approximately 25 feet in height. Both of these areas would be thinned at least once prior to harvest. Gravel roads would be placed so that they would minimize the number of trees to be removed and such that those that are removed are consistent with future thinning efforts. A third gravel road would be added within the electrical transmission ROW, but no tree clearing would be required to place that road. Total length of the new roads would be approximately 1,000 feet, with each of the roads terminating at a well or piezometer. Because of the relatively small area involved, approximately 0.25 acre of new gravel road, no significant impacts on non-sensitive habitats are expected to result from the Proposed Action.

### **4.4.3.2 No-Action Alternative**

Under the No-Action Alternative no wells, pumps, or piping would be installed and no ground disturbance would result. Therefore, no impacts on non-sensitive habitats would result from implementation of the No-Action Alternative.

## **4.4.4 Sensitive Habitats**

Sensitive habitats may be impacted by construction activities, routine monitoring that would follow construction of the system, or discharge of the water from the air stripper. This section identifies potential impacts on sensitive habitats and describes project design features that avoid such impacts.

#### 4.4.4.1 Proposed Action

The Proposed Action would not impact wetlands or streams. No wetlands would be crossed by the proposed water line and none of the wells or piezometers would be located within wetlands (Figure 4-1). Two streams would be crossed by the water line (Figure 4-1), but without impact because the water line would be placed in the soil above the culvert of the road crossing. No drilling or trenching would occur in streams. Silt fencing and soil stabilization would be used to eliminate or reduce runoff into and prevent impacts on these sensitive habitats.

The Proposed Action would not be within any area currently designated for Barrens restoration (Figure 4-5). Three monitoring wells would be located along the edge of a Barrens Restoration Area, but these wells would be located in the road ROW and would not impact Barrens restoration.

Because the wells, water line, and pumps would be placed entirely within road and electrical transmission ROWs and management units designated for pine pulp/sawtimber production, there is no potential to impact forested land on Arnold AFB.

#### 4.4.4.2 No-Action Alternative

Under the No-Action Alternative no wells, pumps, or piping would be installed and no ground disturbance would result. Therefore, no impacts on sensitive habitats, including wetlands, would result from implementation of the No-Action Alternative.

### 4.5 Cultural Resources

Impacts analysis focuses on the potential for the Proposed Actions to affect the quality and utility of significant historical and cultural resources.

#### 4.5.1 Proposed Action

The project area was previously screened for cultural resources. The areas where the wells and piezometers would be placed were investigated for cultural resources concerns through consultation with the State Historic Preservation Office (SHPO) in 2003. This effort was documented in Archeological Assessment Report No. 300 (R. Alvey, personal communication, 2004). There are no significant or potentially significant cultural resources in the area where the extraction wells, monitoring wells, and piezometers would be constructed. The water line would be placed in existing maintained ROW. Much of this road ROW was included in the 2003 SHPO consultation, and the remaining eastern portion has been disturbed during previous work (road building and utility installation) (R. Alvey, personal communication, 2004). Two roads must be constructed to support installation and sampling of the extraction and monitoring well network. Shovel tests were conducted in the proposed road ROWs during July and August 2004. No cultural resources were discovered in the ROWs. Therefore, no significant impacts on cultural resources are expected to result from implementation of the Proposed Action.

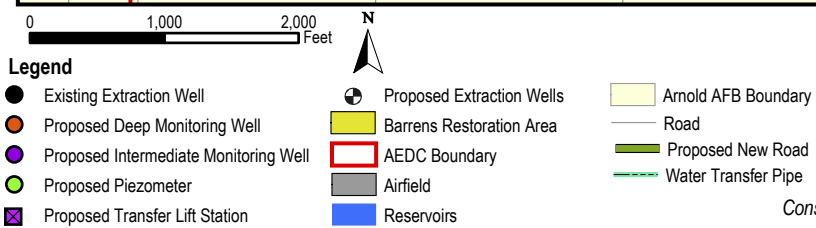
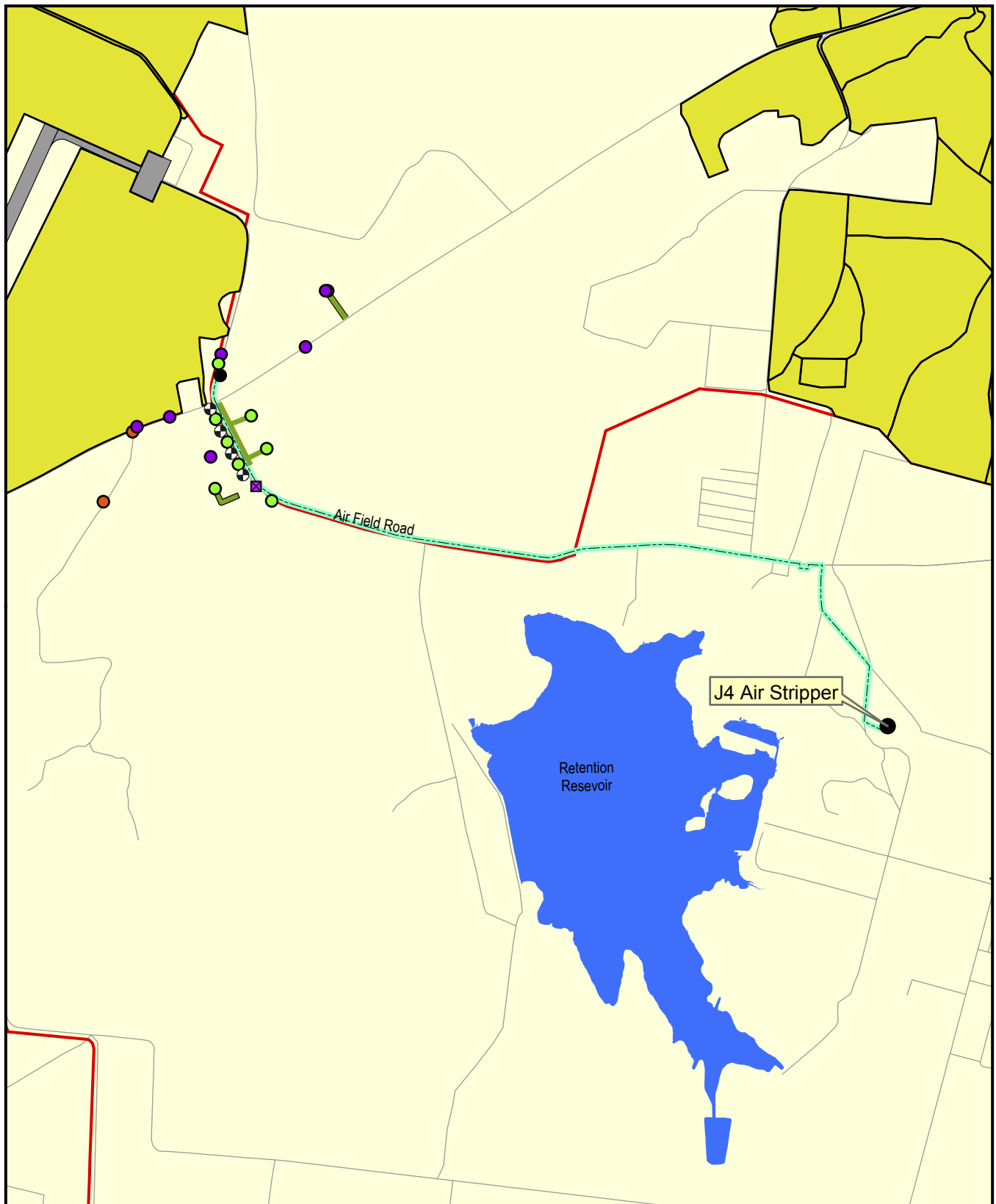


Figure 4-5

**Barrens Restoration Area  
near the Proposed Project Area**

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#### **4.5.2 No-Action Alternative**

Under the No-Action Alternative, no wells, pumps, or piping would be installed and no ground disturbance would result. Therefore, no impacts on cultural resources would result from implementation of the No-Action Alternative.

### **4.6 Traffic Flow and Utility Infrastructure**

#### **4.6.1 Proposed Action**

Air Field Road is routinely closed for short periods during tests at the J6 Test Cell. This road carries only light traffic most of the time. The construction of the wells, piezometers, and water line would not cause substantial impacts on traffic flow on Air Field Road. It may be necessary to temporarily close one lane of the road while equipment and materials are moved, but traffic control with flagmen would allow traffic to continue to move without undue delays. Existing underground utilities at the J6 Test Cell would be identified in advance of installation and avoided during construction to prevent impacts.

#### **4.6.2 No-Action Alternative**

Implementation of the No-Action Alternative would have no impact on traffic flow or utility infrastructure.

## 5.0 Plan, Permit, and Management Requirements

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The Proposed Action would utilize the existing NPDES permitted discharge at the J4 Test Cell GWTU. There would be no need to obtain an additional NPDES permit or to conduct additional NPDES permit monitoring on the discharge.

Arnold AFB would be required to register this extraction well system with TDEC Division of Water Supply pursuant to the Water Resources Information Act (202 TCA, Section 69-8-301).

As no impacts on waters of the United States or Waters of the State of Tennessee would occur, there would be no need to obtain CWA Section 404 permitting from USACE for the Proposed Action. Because no impacts on waters of the State of Tennessee would occur, there would be no need to obtain CWA Section 401 water quality certification or a Tennessee Aquatic Resources Alteration Permit from TDEC for the Proposed Action.

There is a regulatory requirement to obtain a stormwater permit if 1 acre (43,560 square feet) or more of land is disturbed during construction (Jennifer Innis, TDEC, personal communication, July 2004). Installation of approximately 1.5 miles (7,920 feet) of 4- and 6-inch HDPE water line would be required to convey groundwater to the existing J4 GWTU. Installation of the water line would require excavation of a trench approximately 1.5 feet wide and 7,920 feet long. The total square footage for the water line construction area would be approximately 11,880 square feet (0.3 acre). Installation of the water line and the associated laydown areas would impact less than 1 acre of land; therefore, a stormwater permit would not be required. Appropriate erosion and sediment control measures would be implemented to control runoff.

## 6.0 List of Preparers

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Russell Short/Senior Project Manager/28 years of experience/Master of Arts

Rich Reaves/Environmental Scientist/9 years of experience/Ph.D.

Dawn Abercrombie/GIS Analyst/6 years of experience/Master of Science

David Dunagan/Technical Editor/25 years of experience/Master of Arts

## 7.0 List of Contacts

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Richard McWhite, Civ AEDC/SED

Rick Alvey, Aerospace Testing Alliance Natural Resources

Steve Farrington, Aerospace Testing Alliance Natural Resources

Kevin Fitch, Aerospace Testing Alliance Natural Resources

Mark Moran, Aerospace Testing Alliance Natural Resources

Ed Roworth, Aerospace Testing Alliance Natural Resources

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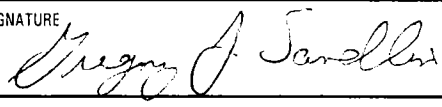
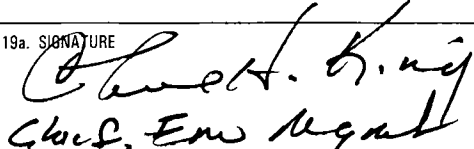
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**Appendix A**  
**Air Force Form 813 —**  
**Request for Environmental Impact Analysis**

REQUEST FOR ENVIRONMENTAL IMPACT ANALYSIS			Report Control Symbol RCS: AAFB-04-044	
INSTRUCTIONS: Section I to be completed by Proponent; Sections II and III to be completed by Environmental Planning Function. Continue on separate sheets as necessary. Reference appropriate item number(s).				
<b>SECTION I - PROPONENT INFORMATION</b>				
1. TO (Environmental Planning Function) <del>Mark Moran</del> , Natural Resources Manager <b>Rick M. White</b>		2. FROM (Proponent organization and functional address symbol) IRP-SS42		2a. TELEPHONE NO. 4428
3. TITLE OF PROPOSED ACTION SWMU 74 Groundwater Containment System				
4. PURPOSE AND NEED FOR ACTION (Identify decision to be made and need date) Containment of SWMU 74 contaminated groundwater prior to plume exit from AAFB boundary.				
5. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES (DOPAA) (Provide sufficient details for evaluation of the total action.) Installation of groundwater extraction wells, monitoring wells, piezometer nests, well vaults, lift stations, and underground piping from location on Airport Road piped to J4 groundwater treatment unit sump.				
6. PROPONENT APPROVAL (Name and Grade) Greg Sandlin, PE		6a. SIGNATURE 		6b. DATE 11 MAR 04
<b>SECTION II - PRELIMINARY ENVIRONMENTAL SURVEY.</b> (Check appropriate box and describe potential environmental effects including cumulative effects.) (+ = positive effect; 0 = no effect; - = adverse effect; U = unknown effect)				
7. AIR INSTALLATION COMPATIBLE USE ZONE/LAND USE (Noise, accident potential, encroachment, etc.)		<input type="checkbox"/>	<input checked="" type="checkbox"/> 0	<input type="checkbox"/>
8. AIR QUALITY (Emissions, attainment status, state implementation plan, etc.)		<input type="checkbox"/>	<input checked="" type="checkbox"/> X	<input type="checkbox"/>
9. WATER RESOURCES (Quality, quantity, source, etc.)		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> X
10. SAFETY AND OCCUPATIONAL HEALTH (Asbestos/radiation/chemical exposure, explosives safety quantity-distance, bird/wildlife aircraft hazard, etc.)		<input type="checkbox"/>	<input checked="" type="checkbox"/> X	<input type="checkbox"/>
11. HAZARDOUS MATERIALS/WASTE (Use/storage/generation, solid waste, etc.)		<input type="checkbox"/>	<input checked="" type="checkbox"/> X	<input type="checkbox"/>
12. BIOLOGICAL RESOURCES (Wetlands/floodplains, threatened or endangered species, etc.)		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> X
13. CULTURAL RESOURCES (Native American burial sites, archaeological, historical, etc.)		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> X
14. GEOLOGY AND SOILS (Topography, minerals, geothermal, Installation Restoration Program, seismicity, etc.)		<input type="checkbox"/>	<input checked="" type="checkbox"/> X	<input type="checkbox"/>
15. SOCIOECONOMIC (Employment/population projections, school and local fiscal impacts, etc.)		<input type="checkbox"/>	<input checked="" type="checkbox"/> X	<input type="checkbox"/>
16. OTHER (Potential impacts not addressed above.)		<input type="checkbox"/>	<input checked="" type="checkbox"/> X	<input type="checkbox"/>
<b>SECTION III - ENVIRONMENTAL ANALYSIS DETERMINATION</b>				
17.	<input type="checkbox"/> PROPOSED ACTION QUALIFIES FOR CATEGORICAL EXCLUSION (CATEX) # _____ ; OR <input checked="" type="checkbox"/> PROPOSED ACTION DOES NOT QUALIFY FOR A CATEX; FURTHER ENVIRONMENTAL ANALYSIS IS REQUIRED.			
18. REMARKS  An Environmental Assessment (EA) is required. See Continuation Sheet.				
19. ENVIRONMENTAL PLANNING FUNCTION CERTIFICATION (Name and Grade) FRANK A. DUNCAN, GS-13 Deputy, Environmental Mgt. Division		19a. SIGNATURE 		19b. DATE 24 Mar 04

18. AAFB-04- 044

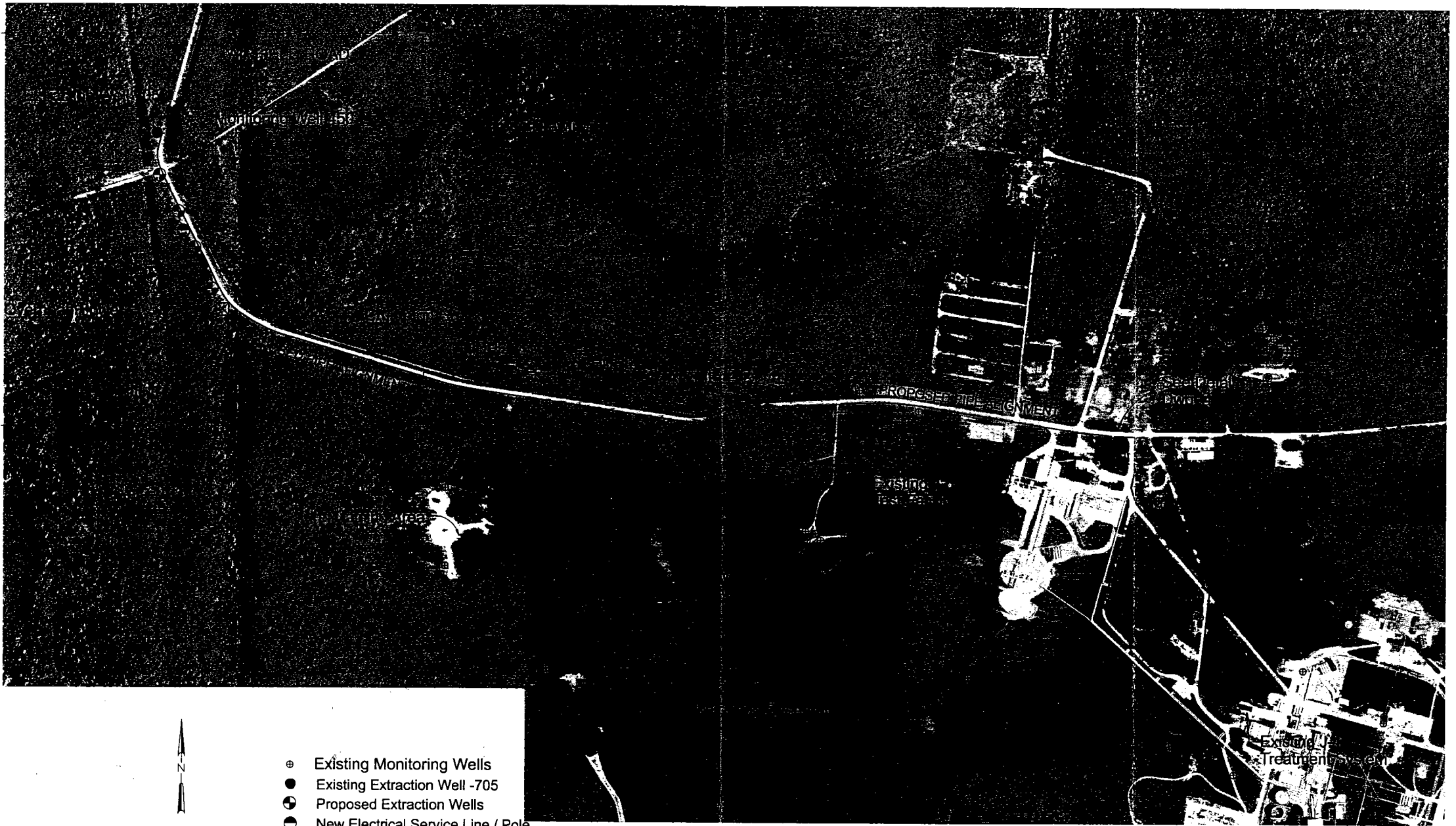
**Interdisciplinary Team Review**Public Affairs: No issues.

Compliance (Air/Water): This operation may be impacted by the Water Withdrawal Registration requirements. It is a violation of TDEC regulations for anyone to withdraw, on average, 10,000 gallons per day without having registered with the State. An Aquatic Resource Alteration Permit (ARAP) will be required if the pipeline is installed in Crumpton Creek.

Natural Resources: There are some Eggert's sunflower occurrences near some of the proposed well locations. There is also a state listed species located in Crumpton Creek.

*Rum*  
Cultural Resources: Four proposed monitoring well nests are located in the mowed powerline. The powerline ROW has not been previously been investigated for cultural resources. When the final locations of these four proposed wells are marked in the field then they will need to be shovel tested. The Hills Chapel Cemetery is adjacent to the proposed affected areas and it will need to be avoided. If cultural remains are inadvertently found in the cleared areas during construction of the wells and monitoring stations then they will need to be assessed by the base archaeologist.

Hazardous Materials: No issues.Hazardous Waste: No issues.Restoration: No issues.Safety/Health: No issues.



- ⊕ Existing Monitoring Wells
- Existing Extraction Well -705
- ⊕ Proposed Extraction Wells
- New Electrical Service Line / Pole
- ⊠ Proposed Transfer Lift Station
- ⊥ Blind Flange for Future Connection

PRELIMINARY

NOT FOR  
CONSTRUCTION

DSGN	D. McCrackin
DR	B. Helton
CHK	
APVD	

NO.	DATE	REVISION	BY	APVD

VERIFY SCALE  
BAR IS ONE INCH ON  
ORIGINAL DRAWING.  
IF NOT ONE INCH ON  
THIS SHEET, ADJUST  
SCALES ACCORDINGLY

**CH2MHILL**

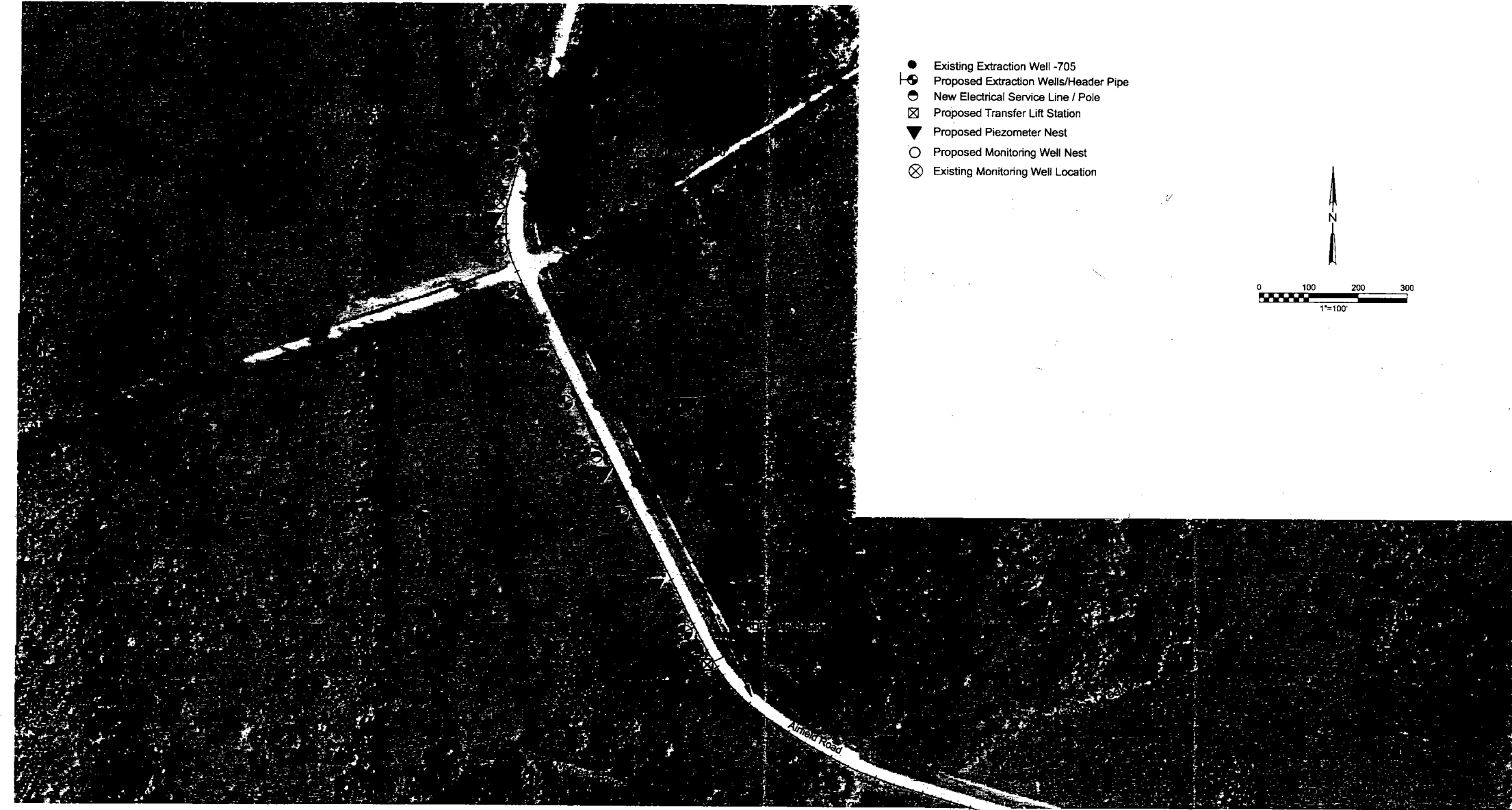
ARNOLD AIR FORCE BASE  
OVERALL SITE AND PIPING PLAN  
GROUNDWATER EXTRACTION, CONVEYANCE  
AND TREATMENT SYSTEM

SHEET	2
DWG	DRAWING-2
DATE	11/18/03
PROJ	184504.31.01

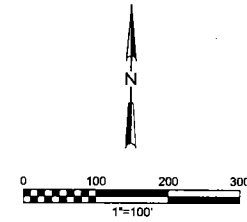
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- Existing Extraction Well -705
- ⊕ Proposed Extraction Wells/Header Pipe
- New Electrical Service Line / Pole
- ⊠ Proposed Transfer Lift Station
- ▼ Proposed Piezometer Nest
- Proposed Monitoring Well Nest
- ⊗ Existing Monitoring Well Location



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PRELIMINARY

NOT FOR  
CONSTRUCTION

DSGN	D McCrackin						VERIFY SCALE
DR	B. Helton						BAR IS ONE INCH ON ORIGINAL DRAWING.
CHK							0
APVD							IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
	NO.	DATE		REVISION	BY	APVD	

CH2MHILL

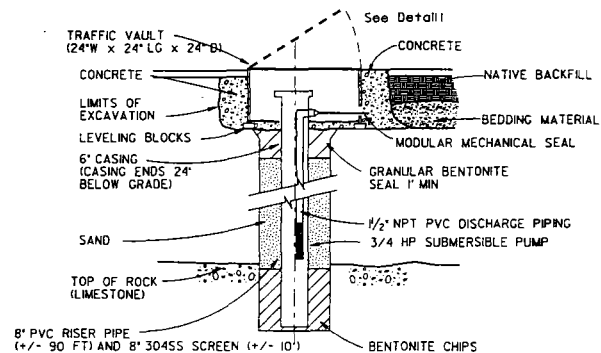
ARNOLD AIR FORCE BASE  
MW-450 AREA  
SITE PLAN

SHEET	3
DWG	DRAWING-3
DATE	11/18/03
PROJ	184504.31.01

FILENAME: Drawing-3.dgn

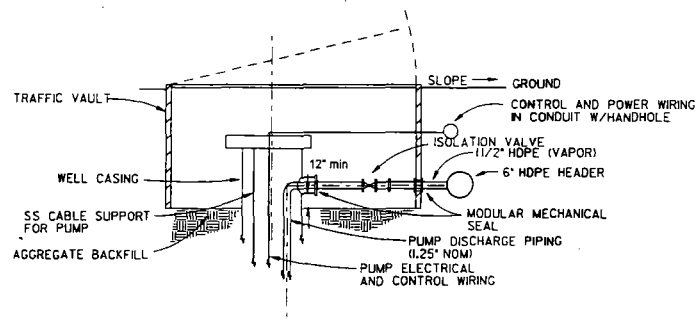
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PLOT TIME:



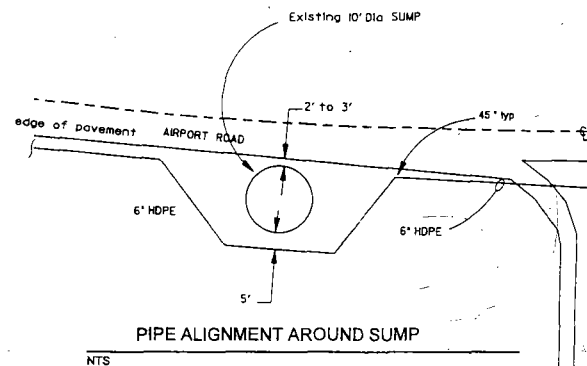
EXTRACTION WELL

NTS



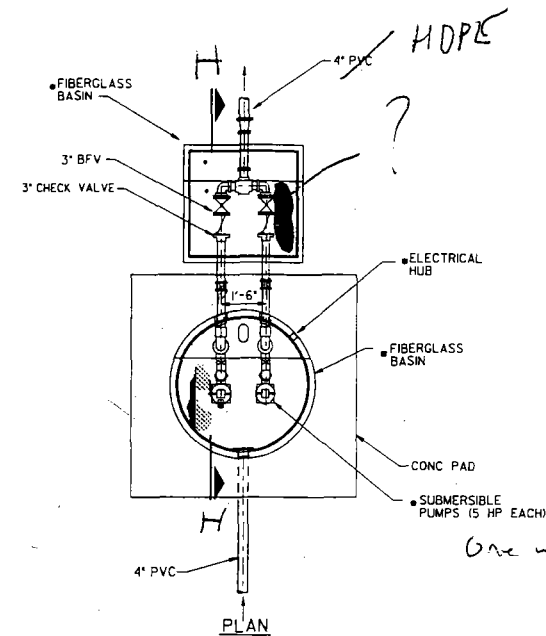
DETAIL 1

NTS

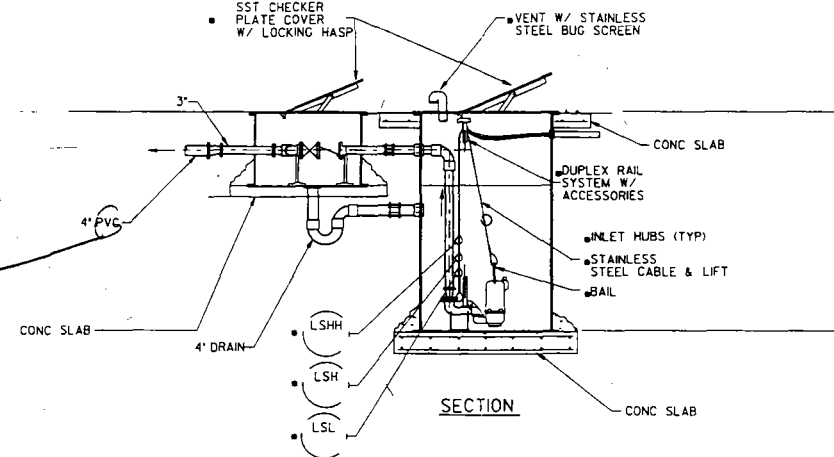


PIPE ALIGNMENT AROUND SUMP

NTS



PLAN



SECTION

TRANSFER LIFT STATION DETAIL

NTS

520-IC-014

PRELIMINARY

NOT FOR  
CONSTRUCTION

DSGN D.McKRACKIN  
DR BHELTON  
CHK  
APVD

NO. DATE

REVISION

BY

APVD

VERIFICATION SCALE  
BAR IS ONE INCH ON  
ORIGINAL DRAWING.  
0 1"  
IF NOT ONE INCH ON  
THIS SHEET, ADJUST  
SCALES ACCORDINGLY

CH2MHILL

ARNOLD AIR FORCE BASE  
DETAILS AND SECTIONS

SHEET 4  
DWG DRAWING-4  
DATE 11/21/2003  
PROJ 184504.31.01

FILENAME: DRAWING 4.DGN PLOT DATE: 16-DEC-2003

PLOT TIME:

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## **Appendix B**

### **Plant Associations Occurring on Arnold Air Force Base**

## **FOREST**

### **Planted/Cultivated**

*Pinus taeda* Planted Forest

### **Natural**

#### **Upland Forest**

*Quercus falcata* - *Quercus coccinea* - *Quercus (stellata, velutina)* / *Vaccinium pallidum* Forest

*Quercus falcata* - *Quercus alba* - (*Quercus coccinea*) / *Oxydendrum arboreum* / *Vaccinium pallidum* Forest

*Quercus alba* - *Quercus (falcata, stellata)* / *Chasmanthium laxum* Forest

*Juniperus virginiana* var. *virginiana* - *Quercus* spp. Forest

*Juniperus virginiana* var. *virginiana* / *Rhus copallinum* / *Schizachyrium scoparium* Forest

#### **Wetland Forest**

*Quercus lyrata* / *Betula nigra* / *Pleopeltis polypodioides* Forest

*Quercus phellos* - *Quercus alba* / *Vaccinium fuscatum* - (*Viburnum nudum*) / *Carex (barrattii, intumescens)* Forest

*Liquidambar styraciflua* Forest

*Quercus phellos* - *Quercus nigra* - (*Nyssa biflora*) Forest

*Nyssa aquatica* / *Cephalanthus occidentalis* Forest

#### **Floodplain - Floodplain Terrace / Bottomland Forest**

*Quercus alba* - *Carya (alba, ovata)* - *Liriodendron tulipifera* -(*Quercus phellos*) / *Cornus florida* Forest

*Quercus nigra* - *Quercus (alba, phellos)* Forest

*Liquidambar styraciflua* - *Quercus michauxii* - *Carya laciniosa* / *Fagus grandifolia* -(*Aesculus flava*) Forest

*Quercus velutina* - *Carya (alba, glabra)* / *Vaccinium arboreum* Forest

*Platanus occidentalis* - (*Liquidambar styraciflua*, *Acer rubrum*) / (*Carpinus caroliniana*) / *Onoclea sensibilis* Forest

*Salix nigra* - *Acer (rubrum, saccharinum)* / *Alnus serrulata* - *Cephalanthus occidentalis* Forest

## **WOODLAND**

*Quercus (falcata, stellata)* / *Quercus marilandica* / *Gaylussacia (baccata, dumosa)* Woodland

*Quercus stellata* - (*Quercus coccinea*) / *Quercus marilandica* / *Vaccinium pallidum* - (*Vaccinium stamineum*) Woodland

## **SHRUBLAND**

### **Upland shrubland**

*Rubus (argutus, trivialis) - Smilax (glauca, rotundifolia)* Shrubland

### **Wetland shrubland**

*Cephalanthus occidentalis - Hibiscus moscheutos ssp. moscheutos* Shrubland

## **HERBACEOUS VEGETATION**

### **Upland Grassland**

*Andropogon gerardii - (Andropogon glomeratus, Panicum virgatum, Sorghastrum nutans)*  
Herbaceous Vegetation

*Andropogon gerardii - Schizachyrium scoparium - (Calamagrostis coarctata, Panicum virgatum)*  
Herbaceous Vegetation

*Schizachyrium scoparium - Andropogon (gyrans, ternarius, virginicus)* Herbaceous Vegetation

*Schizachyrium scoparium - Calamagrostis coarctata* Herbaceous Vegetation

*Andropogon virginicus var. virginicus* Herbaceous Vegetation

### **Wetland Grassland**

*Juncus effusus* Herbaceous Vegetation

*Eleocharis microcarpa - Juncus repens - Rhynchospora corniculata - (Mecardonia acuminata - Proserpinaca spp)* Herbaceous Vegetation

*Panicum hemitomon - Dulichium arundinaceum* Herbaceous Vegetation

*Saccharum baldwinii - Calamagrostis coarctata - Panicum rigidulum - Rhynchospora capitellata*  
Herbaceous Vegetation

*Scirpus cyperinus - Panicum rigidulum var. elongatum - Rhynchospora corniculata* Herbaceous  
Vegetation

*Typha latifolia* Herbaceous Vegetation

### **Wetland Perennial Forb**

*Pontederia cordata - Sagittaria graminea - Sagittaria latifolia* Herbaceous Vegetation

Source: Call, 2003

## **Appendix C**

### **Sensitive Species Known to Occur on Arnold Air Force Base**

Plants		Designated Status		Rank	
		Federal	Tennessee	Global	Tennessee
<i>Agalinis pseudophylla</i>	Shinner's false-foxglove	C2*	E	G2?Q	S1
<i>Asclepias hirtella</i>	Prairie milkweed		S	G5	S1
<i>Carex barrattii</i>	Barrat's sedge		E	G4	S1
<i>Carex buxbaumii</i>	Brown bog sedge		S	G5	S1
<i>Clethra alnifolia</i>	Coastal sweet pepper-bush		E	G5	S1
<i>Cypripedium acaule</i>	Pink lady's-slipper		E*	G5	S4
<i>Cypripedium kentuckiense</i>	Kentucky lady's-slipper	C2*	E	G3	S1
<i>Dicanthelium aciculare</i>	Needleleaf witchgrass		E	G4G5	S1
<i>Dicanthelium ensifolium</i>	Small-leaved panic grass		S	G?	S1S2
<i>Dicanthelium leucothrix</i>	Roughish witchgrass		S	G4?Q	S1
<i>Drosera brevifolia</i>	Dwarf sundew		T	G5	S2
<i>Echinacea pallida</i>	Pale-purple coneflower		T	G4G5	S1
<i>Eleocharis intermedia</i>	Matted spike-rush		S	G5	S1
<i>Eupatorium leucolepis</i>	White-bract thoroughwort		E	G5	S1
<i>Festuca paradoxa</i>	Cluster fescue		S	G5	S1
<i>Gaylussacia dumosa</i>	Dwarf huckleberry		T	G5	S2S3
<i>Gentiana puberulenta</i>	Prairie gentian		E	G4G5	S1
<i>Gymnopogon brevifolius</i>	Broad-leaved beardgrass		S	G5	S1
<i>Helianthemum propinquum</i>	Low frostweed		S	G4	S1
<i>Helianthus eggertii</i>	Eggert's sunflower	T	T	G2G3	S2
<i>Hypericum adpressum</i>	Creeping St. John's-wort	C2*	T	G2G3	S1
<i>Iris prismatica</i>	Slender blue flag		T	G4G5	S2
<i>Isoetes melanopoda</i>	Blackfoot quillwort		E	G5	S1
<i>Juglans cinerea</i>	White walnut, butternut		T	G3G4	S2S3
<i>Lachnanthes caroliniana</i>	Carolina redroot		E	G4	S1
<i>Lechea pulchella</i>	Legget's pinweed		E	G5	S1
<i>Lespedeza angustifolia</i>	Narrowleaf bushclover		T	G5	S2
<i>Lilium michiganense</i>	Michigan lily		T	G5	S2
<i>Liparis loeselii</i>	Fen orchis		E	G5	S1
<i>Listera australis</i>	Southern twayblade		E	G4	S1S2
<i>Lobelia canbyi</i>	Canby's lobelia		T	G4	S2S3
<i>Ludwigia sphaerocarpa</i>	Globe fruited false loosestrife		T	G5	S1
<i>Lycopodiella alopecuroides</i>	Foxtail clubmoss		T	G5	S1
<i>Marshallia trinervia</i>	Broad-leaved Barbara's		T	G3	S2
<i>Muhlenbergia glaberrima</i>	buttons		S	G4?	S1
<i>Muhlenbergia torreyana</i>	Hair grass		E	G3	S1
<i>Myriophyllum pinnatum</i>	Torrey's dropseed		T	G5	S1
<i>Panicum acuminatum var. densiflorum</i>	Cutleaf water-milfoil		E	G4G5	S1
<i>Panicum hemitomon</i>	Eaton's witchgrass		S	G5?	S1S2
<i>Platanthera integra</i>	Maidencane		E	G5?	S1
<i>Pogonia ophiglossoides</i>	Yellow fringeless orchid		T	G5	S2
<i>Polygala mariana</i>	Rose pogonia		S	G5	S1
<i>Polygala nuttallii</i>	Maryland milkwort		E	G5	S1
<i>Prenanthes aspera</i>	Nuttall's milkwort		PE	G4?	S1
<i>Prunus pumila</i>	Harsh rattlesnake-root		T	G5	S1
<i>Ranunculus flabellaris</i>	Sand cherry		T	G5	S2
<i>Rhyncospora perplexa</i>	Yellow water crowfoot		T	G5	S2
<i>Sagittaria graminea</i>	Obscure beak-rush		T	G5	S1
	Grass-leaved arrow head				

C2 indicates a species formerly classified as a federal candidate species.

T = Threatened, E = Endangered, S = Special Concern

Rank is an indication of global and state rarity ranging from 1 (most rare) to 5 (most common)

? = inexact numeric rank

Q = taxonomic status is questionable, numeric rank may change with taxonomy

T = taxonomic subdivision (trinomial)

Animals		Designated Status		Rank	
		Federal	Tennessee	Global	Tennessee
<i>Accipiter striatus</i>	Sharp-shinned Hawk		D	G5	S2
<i>Aimophila aestivalis</i>	Bachman's Sparrow	C2	E	G3	S2
<i>Ambystoma talpoideum</i>	Mole Salamander		D	G5	S4
<i>Ammodramus henslowii</i>	Henslow's Sparrow	C2		G4	SPB
<i>Ammodramus savannarum</i>	Grasshopper Sparrow		D	G5	S4
<i>Circus cyaneus</i>	Northern Harrier		D	G5T?	S1N
<i>Haliaeetus leucocephalus</i>	Bald Eagle	T	T	G4	S1
<i>Hemidactylium scutatum</i>	Four-toed salamander		D	G5	S3
<i>Hemitremia flammea</i>	Flame Chub		D	G4	S4
<i>Hyla gratiosa</i>	Barking Tree Frog		D	G5	S3
<i>Myotis grisescens</i>	Gray Bat	E	E	G2G3	S2
<i>Napaeozapus insignis</i>	Woodland Jumping Mouse		D	G5	S4
<i>Ophisaurus attenuatus</i>	Eastern Slender Glass Lizard		D	G5T5	S3
<i>Pituophis melanoleucus melanoleucus</i>	Northern Pine Snake	C2	T	G5T4	S3
<i>Pleurobema gibberum</i>	Cumberland Pigtoe	E	E	G1	S1
<i>Rana capito</i>	Gopher Frog	C1NL		G4T3	S1
<i>Sorex cinereus</i>	Masked Shrew		D	G5	S4
<i>Sorex fumeus</i>	Smoky Shrew		D	G5	S4
<i>Sorex longirostris</i>	Southeastern Shrew		D	G5	S4
<i>Zapus hudsonius</i>	Meadow Jumping Mouse		D	G5	S4

C2 and C1NL indicate species formerly classified as a federal candidate species.

T = Threatened, E = Endangered, D = Deemed in Need of Management

Rank is an indication of global and state rarity ranging from 1 (most rare) to 5 (most common)

Source: Call, 2003



## **Appendix D**

### **Conservation Target Species Occurring in Wetlands on Arnold Air Force Base**

## Conservation Target Species Occurring in Wetland Flats

*Carex barrattii* (Barrat's sedge)  
*Iris prismatica* (Slender blue flag)  
*Listera australis* (Southern twayblade)  
*Lycopodiella alopecuroides* (Foxtail clubmoss)  
*Muhlenbergia torreyana* (Torrey's dropseed)  
*Platanthera flava* var. *flava* (Southern rein-orchid)  
*Trillium pusillum* var. *pusillum* (Least trillium)  
*Vaccinium macrocarpon* (Cranberry)  
*Zigadenus leimanthoides* (Death camas)

## Conservation Target Species Occurring in Wetland Depressions

*Ambystoma talpoideum* (Mole salamander)  
*Hemidactylium scutatum* (Four-toed salamander)  
*Rana capito* (Gopher frog)  
*Clethra alnifolia* (Coastal sweet pepperbush)  
*Hypericum adpressum* (Creeping St. John's-wort)  
*Lachnanthes caroliniana* (Carolina redroot)  
*Ludwigia sphaerocarpa* (Globe-fruited false loosestrife)  
*Panicum aciculare* (Needleleaf witchgrass)  
*P. acuminatum* var. *densiflorum* (Eaton's witchgrass)  
*P. acuminatum* var. *leucothrix* (Roughish witchgrass)  
*P. ensifolium* (Small-leaved panicgrass)  
*P. hemitomon* (Maidencane)  
*Rhynchospora perplexa* (Obscure beakrush)  
*Sagittaria graminea* (Grass-leaved arrowhead)  
*Vaccinium elliotii* (Mayberry)  
*Woodwardia virginica* (Virginia chainfern)  
*Xyris fimbriata* (Fringed yellow-eyed-grass)  
*X. iridifolia* (Wide-leaved yellow-eyed-grass)

Source: Call, 2003